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# HERBICIDE CONTROL OF SAGEBRUSH AND WYETHIA IN WYOMING

Intermountain Forest and Range Experiment Station
Ogden, Utah

29 March 1973

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U.S.D.A. FOREST SERVICE ENVIRONMENTAL

STATEMENT

# HERBICIDE CONTROL OF SAGEBRUSH AND WYETHIA IN WYOMING

Final Statement

Prepared in Accordance with
Section 102(2)(C) of P. L. 91-190

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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
R-4

REPLY TO 1940 Environmental Statements

MAR 29 1973

SUBJECT: EIS 730576F
USDA Final Environmental Statement on
Herbicide Control of Sagebrush and Wyethia in Wyoming

TO Honorable Russel E. Train, Chairman
Council on Environmental Quality

THROUGH: T. C. Byerly, Coordinator of
Environmental Quality Activities

Enclosed are ten copies of the final environmental statement on Herbicide Control of Sagebrush and Wyethia in Wyoming issued by the Forest Service Regional Forester, Intermountain Region. One copy is for submittal to National Technical Information Service.

The responsible official is Regional Forester Vern Hamre, 324 - 25th Street, Ogden, Utah 84401.

Adrian W. Gilbert

Philip L. Thornton
Deputy Chief, Forest Service

Enclosure

APR 5 1973

U.S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

| | | |
|---|---|---|
| I. | Report Number | - USDA-FS-FES (Adm) 73-37 |
| II. | Title | - USDA Final Environmental Statement on Herbicide Control of Sagebrush and Wyethia in Wyoming |
| III. | Responsible Official | - Regional Forester Vern Hamre |
| IV. | Date Filed with CEQ | MAR 29 1973 |
| V. | Prepared by | - U.S. Department of Agriculture<br>Forest Service - Intermountain Region<br>Federal Building<br>Ogden, Utah 84401 |

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# U.S.D.A. FOREST SERVICE ENVIRONMENTAL STATEMENT

# HERBICIDE CONTROL OF SAGEBRUSH AND

# WYETHIA IN WYOMING

Final Statement

Prepared in Accordance with
Section 102(2)(C) of P.L. 91-190

February 1973

Intermountain Region

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U.S.D.A. FOREST SERVICE ENVIRONMENTAL STATEMENT

HERBICIDE CONTROL OF SAGEBRUSH AND WYETHIA IN WYOMING

Prepared in Accordance with
Section 102(2)(C) of P.L. 91-190

Summary Sheet

I. Draft ( ) Final ( X )

II. Name of Agency: Intermountain Region, Forest Service, USDA

III. Administrative ( X ) Legislative ( )

IV. Description of Action

This statement applies to National Forest land administered by the Intermountain Region of the Forest Service, U.S. Department of Agriculture, in that part of western Wyoming lying essentially west of the Continental Divide. It covers the practice of applying the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) to approximately 2,000 acres each year of land covered by dense stands of sagebrush and wyethia.

V. Environmental Impacts

The proposal will have a limited impact on the environment by reducing the density of susceptible plant species. Research shows that a minor amount of chemical may find its way to water supplies and to the soil. This contamination is short lived. The risk of serious adverse effects is negligible due to careful planning, application, and supervision. The chemicals used are registered for such use by the Environmental Protection Agency.

VI. Alternatives Considered

Alternatives considered and often used are: burning, chaining, plowing, different chemicals and formulations, biological control, intensive land management, and no action at all.

VII. Consultation With Others

A. General

Fifty-six copies of the draft environmental statement were mailed out for comment. In addition, a notice of the availability of the statement was sent to eight newspapers with distribution in Wyoming. Nine responses were received. A number of groups and

id

individuals have been verbally contacted regarding this proposal. The draft statement contained a partial list of contacts made by various Forest Service officers.

B. Agencies, Groups, and Individuals Responding to the Draft Statement and Others to Whom the Final Statement Will Be Sent

Mr. William M. Hoffman — 3 copies
Office of Pesticides Programs
Environmental Protection Agency
Washington, D. C. 20460

Mr. John A. Green
Regional Administrator
Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Mr. Bruce Blanchard, Director — 18 copies
Office of Environmental Project Review
U.S. Department of the Interior
Main Interior Building, Room 5313
19th and C Streets N.W.
Washington, D. C. 20240

Department of Health, Education, and Welfare
330 Independence Avenue S.W.
Washington, D. C. 20201

Dr. Robert Harris, Director — 4 copies
Intermountain Forest and Range
Experiment Station
Forest Service Building, 25th and Adams
Ogden, Utah 84401

Mr. Daniel P. Baker, Wyoming State Director — 10 copies
Bureau of Land Management,
U.S. Department of the Interior
U.S. Post Office and Court House
2120 Capitol Avenue
P.O. Box 1828
Cheyenne, Wyoming 82001

Mr. Blaine O. Holliday, State Conservationist — 5 copies
Soil Conservation Service,
U.S. Department of Agriculture
P.O. Box 2440
Casper, Wyoming 82601

Dr. A. C. Hull, Range Scientist
Agricultural Research Service, USDA
U.M.C. 63 Crops Research Laboratory
Utah State University
Logan, Utah 84322

Dr. E. H. Cronin, Plant Physiologist
Agricultural Research Service, USDA
U.M.C. 63
Utah State University
Logan, Utah 84322

State Planning Coordinator
Office of the Governor
Capitol Building
Cheyenne, Wyoming 82001

Mr. James B. White, Director — 5 copies
Wyoming Game and Fish Commission
P.O. Box 1589
Cheyenne, Wyoming 82001

Dr. Lloyd C. Ayres, Asst. Dean and Director — 3 copies
College of Agriculture
University of Wyoming
University Station, Box 3354
Laramie, Wyoming 82070

Dr. Harold P. Alley, Professor of Weed Science
Plant Science Division, College of Agriculture
University of Wyoming
University Station, P.O. Box 3354
Laramie, Wyoming 82070

Dr. Alan A. Beetle
Plant Science Division, College of Agriculture
University of Wyoming
University Station, P.O. Box 3354
Laramie, Wyoming 82070

Mr. Thomas Bedell, Range Management Specialist
State Extension Service
Box 3354, University Station
Laramie, Wyoming 82070

Mr. John C. Borzea, Director
Wyoming Wildlife Federation
1306 Kimberly Avenue
Rock Springs, Wyoming 82901

Mr. Edwin J. Merrick
Field Representative
National Wildlife Federation
710 South 41st Street
Boulder, Colorado 80302

Mr. Burton W. Marston, Chairman
Public Lands Committee
The Izaak Walton League of America
370 North Ninth Street
Laramie, Wyoming 82070

Mr. Meridan H. Bennett
Wyoming Outdoor Coordinating Council
Box 33
Wilson, Wyoming 83014

Mr. Robert P. Bledsoe, Executive Secretary
Wyoming Wool Growers Association
300 North Center
P.O. Box 115
Casper, Wyoming 82601

Mr. Dean T. Prosser, Jr., Secretary
Wyoming Stock Growers Association
P.O. Box 216
Cheyenne, Wyoming 82001

VIII. Date Draft Environmental Statement Made Available to Council on Environmental Quality: December 1, 1972, and to the Public: December 6, 1972.

Date Final Environmental Statement Made Available to Council on Environmental Quality:

U.S.D.A. FOREST SERVICE ENVIRONMENTAL STATEMENT

Herbicide Control of Sagebrush and Wyethia in Wyoming

Prepared in Accordance with
Section 102(2)(C) of P.L. 91-190

Type of Statement: Final

Date of Transmission to CEQ: MAR 29 1973

Type of Action: Administrative

Responsible Official: Regional Forester Vern Hamre
USDA, Forest Service, Region 4
324 25th Street
Ogden, Utah 84401

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USDA FOREST SERVICE ENVIRONMENTAL STATEMENT
**Herbicide Control of Sagebrush and Wyethia in Wyoming**

Prepared in Accordance with
Section 102(2)(C) of P.L. 91-190

## INTRODUCTION

The National Environmental Policy Act of 1969, and guidelines issued by the Council on Environmental Quality in 1971, require preparation of environmental statements on major Federal actions or the accumulation of actions which may significantly affect the quality of the human environment. Statements are also required for actions which are likely to be highly controversial as is the use of herbicides. National Forests in Wyoming have for many years used various methods of manipulating the composition of vegetation where an imbalance has occurred. This environmental statement is prepared to describe the accumulation of impacts or potential impacts resulting from the use of a light application of 2,4-D on many small projects over a period of several years. In recent years, the use of pesticides has become controversial.

This environmental statement covers the use of 2,4-D on selected areas of approximately 2,000 acres each year, where approximately 20 years of experience have shown that other alternatives are either more expensive or less effective in meeting the land management objectives. It does not deal with individual projects. However, each individual project is studied and evaluated on its own merits, and an environmental analysis report is prepared.

## I. DESCRIPTION

This statement applies to National Forest land administered by the Intermountain Region of the Forest Service, U.S. Department of Agriculture, in that part of Wyoming lying primarily west of the Continental Divide, Figure 1. Vegetative type modification through the use of the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) has been a major practice throughout the West in the past 20 years. This chemical is registered with the Environmental Protection Agency and approved for this use. Each year the program is reviewed by the Federal Working Group on Pesticides from the standpoint of safety and hazard to human health, to livestock crops, to fish and wildlife, and to other elements of the environment.

The effect of a properly applied herbicide treatment, along with proper grazing management, reduces competition from sagebrush and wyethia permitting other native species to reach full production. This provides the variety of vegetation under which hydrologic conditions and soil productivity is enhanced and can become more productive in terms of forage quality and quantity. With careful planning and consideration for all aspects of vegetation manipulation, range type modification can be compatible with other resource values. To assure harmony, it is necessary to know how herbicide treatment affects the environment.

### A. DEFINITIONS USED IN THE STATEMENT

1. Spray Area: Same as "treated area" or the specific area where herbicide is placed.

2. Project Area: The planned area for plant control within which the spray areas are finally laid out. This area contains spray areas and leave areas.

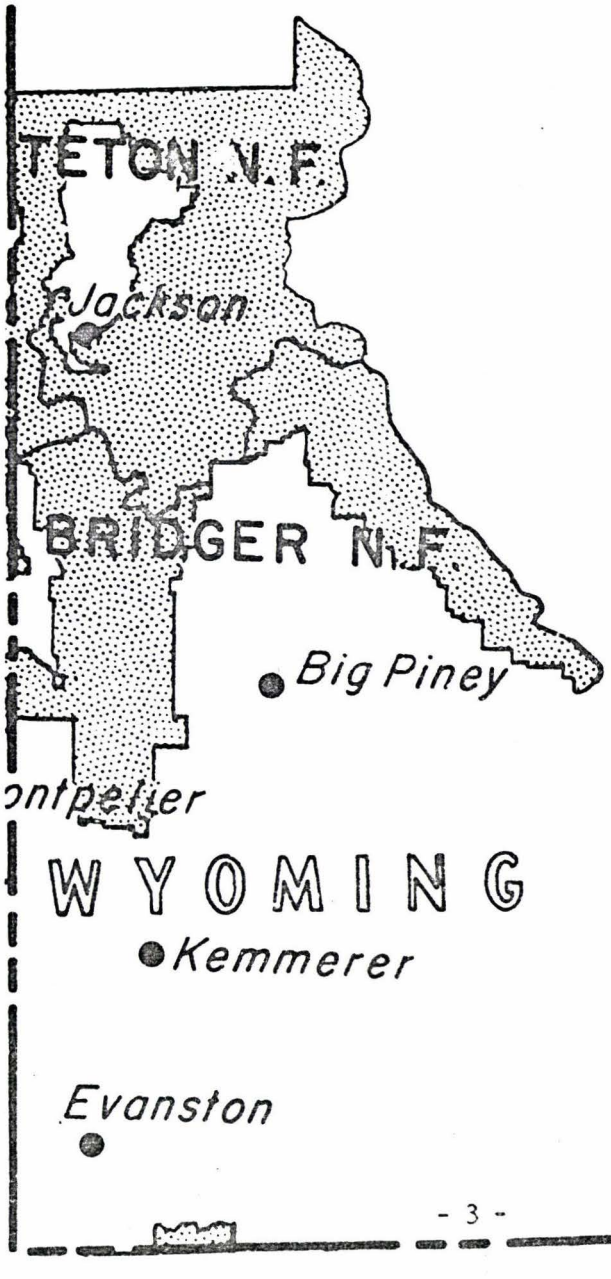
3. Program Area: A large land area where spray operations are planned. This may be a major drainage or other area which includes lands of other ownership. The program area will usually contain all of the seasonal ranges of wildlife species that are in some way dependent on sagebrush.

4. Herbicide Program: For the purpose of this statement the herbicide program is the application of 2,4-D to reduce the density of sagebrush and wyethia.

5. Target Species: The target species are shrubs of the genus Artemisia with species and subspecies of A. tridentata, A. cana, A. longiloba, A. tripartita, and in rare cases, A. arbuscula. The major target forb is dense patches of Wyethia amplexicaulis. Dense patches of this species make up less than 5 percent of the total acreage treated. Wyethia helianthoides is, on rare occasions, a target species.

FIGURE NO. 1

National Forests, Intermountain Region
in the state of Wyoming



B. PURPOSE

The purpose of applying 2,4-D herbicide to dense stands of sagebrush and wyethia is to break up near pure stands or stands strongly dominated by these plants, caused by past disturbances and improper grazing practices, in order that a more diversified and desirable variety of plant species may again become established and productive.

Before immigrant settlement, the western range was used only by wild animals and birds (61). Early explorers reported animals in great numbers in some areas. It is believed that wild and Indian horses were present in large numbers in some areas after about 1700. Despite large animal numbers and natural catastrophies such as extended drought cycles and fire, the range was able to maintain itself, except perhaps for localized areas where animals congregated. With settlement of the West came large numbers of domestic livestock. Without scientific knowledge of range management, improper grazing practices coupled with drought periods soon disrupted the native plant communities. Stable plant communities were broken up and desirable forage and soil stabilizing plants were replaced by less desirable plants. A considerable amount of soil was left poorly vegetated and subject to erosion.

As the ranges deteriorated, and submarginal farmland was abandoned, gullies developed, meadows often dried up, and plants such as sagebrush and wyethia increased to dominate the stands. Plant communities dominated by one species are more subject to catastrophic occurrences. A complex mixture of species provides buffers against the impacts of disease, insects, grazing, fire, drought, and other natural or unnatural impacts.

C. ORIGIN OF THE PROPOSAL

Herbicide project planning is initiated by the District Forest Ranger. Planning is preceded by a detailed soil and vegetation inventory on the project area (69). The project is most often a part of a grazing allotment management plan, but may be applied as part of a wildlife habitat or watershed improvement plan. During the planning stage, usually a period of several years, a detailed environmental analysis is made (60). This analysis evaluates the impact of spraying on the project area and the cumulative impact of other nearby herbicide projects until the entire program area is evaluated. Evaluation does not end with an analysis report but continues through an extended period of time.

The District Ranger develops his plans using the expertise of specialists in ecology, biology, soil science, hydrology, landscape architecture, range science, and other sciences as the need is recognized. Frequently advice is obtained from specialists in other agencies and universities. The services of state wildlife biologists have helped considerably in analysis of effects on wildlife habitat.

D. ECOLOGICAL SYSTEMS

1. Target Vegetation: The sagebrush ecosystem is one of the largest range types on the western range. In 1936 the Forest Service estimated this ecosystem to occupy 96.5 million acres (61). In 1970 the Forest Service developed the "Forest Range Environmental Study" (FRES). This data bank of information was contributed to by several state and Federal agencies and is considered rather accurate. The FRES data shows 94.2 million acres in the sagebrush ecosystem. The difference between the two estimates is considered to be a result of better mapping and inventory procedures and not a significant change in acreage.

a. Sagebrush. The total area dominated by sagebrush-grass vegetation types in the Intermountain Region today has not materially changed since pioneer days (59). Exceptions include acreage converted to intensive agriculture, and areas invaded by sagebrush due to changes in the environment, such as in former meadows where the water table has been lowered through stream channel head cutting (53). However, the understory of grasses and forbs has been seriously depleted and because of the dominant position of sagebrush, the herbaceous understory may not recover for a long time without reducing the sagebrush competition. Thus, the concern is not with a change in acreage of sagebrush, but with the imbalance of plant composition within the sagebrush-grass ecosystem.

The original status of sagebrush or its natural state today is a subject of considerable debate. In order to evaluate management of the sagebrush-grass type, one must have a working knowledge of site potentials and natural makeup of plant composition in the various plant communities. By analysis of relict areas and areas with a known history of light use, one can develop this knowledge. It is far beyond the scope of this statement to describe the sagebrush ecosystem in detail. For additional information the reader is encouraged to review papers on this subject (7, 48, 56, 57, 66). The summary and conclusions of the 1962 paper by Passey and Hugie are presented here for the benefit of the reader that does not wish to research further (48). It should be pointed out that this paper does not separate the subspecies of Artemisia tridentata.

> Vegetation and soils were studied on 66 pristine or long-protected areas of relict native rangeland on foothills and plains of southern Idaho, northern Utah and northeastern Nevada. Qualitative and quantitative values of five species of sagebrush on these locations and their relationship to great soil groups were reported.
>
> One or more species of sagebrush occurred on 64 of the 66 study locations. Sagebrush was present on all zonal Sierozem, Brown and Chestnut soils, on all intrazonal Calcisols, Planosols and Solodized Solonetz, and on all azonal Lithosols, but did not occur on either of the zonal Prairie soils included in the studies. Species dominance, number, age,

herbage production and percent of total herbage production of sagebrush varied within and between great soil groups.

Sagebrush stands were uneven-aged but were dominated by mature plants. Stands dominated by big sagebrush were open and plants were unevenly distributed to form sagebrush savannas. Plants were more closely and more uniformly spaced in stands dominated by threetip, black, low and alkali sagebrush than on stands dominated by big sagebrush.

Big sagebrush occurred more frequently and on a greater variety of soils than did any other sagebrush species. Alkali sagebrush appeared to be the most specific of any species in soil requirements and occurred in dominance only on slightly acid to slightly alkaline Planosols.

Sagebrush produced from 47 to 322 pounds of air-dry herbage and contributed from 9 to 50 percent of total herbage production on these soils where it occurred. The number of sagebrush plants per 1000 square feet of area ranged from 28 to 480.

The oldest big sagebrush plants grew on the driest soils. Size and age of big sagebrush were unrelated.

Even on lands protected from grazing use, the amount and species of sagebrush within a stand may fluctuate because of the influence of insects, disease, fire or climatic factors.

The studies indicated that sagebrush may be a component of the climax or potential native plant community on many of the soils within the area of study.

The data presented will be useful in the technical description of range sites represented by the relicts and, through interpolation and extrapolation of these data, the place of sagebrush in potential native plant communities may be approximated for range sites not represented by suitable relict areas. These data also have value as a basis for planning sagebrush control measures on rangelands.

The sagebrush-grass type may be subdivided into two broad catagories, big sagebrush and low sagebrush. Within each group there are species, subspecies, and forms which differ greatly in the kinds of environments they occupy, their palatability to livestock and wildlife, their reaction to grazing by livestock and wildlife, and their susceptibility and reaction to chemical treatments.

(1) The Low Sagebrush Group. The low sagebrush group is made up of black sagebrush (Artemisia nova); low sagebrush (Artemisia

arbuscula ssp. arbuscula and Artemisia arbuscula ssp. thermopola); and alkali sagebrush (Artemisia longiloba).

(a) Black Sagebrush. This species normally occupies sites of low productive potential. It is moderately palatable for livestock and highly palatable for some wildlife species; consequently, it often decreases with heavy grazing. Because of the productive limitations of its environment and its high forage value, black sagebrush is not a target for chemical treatment.

(b) Low Sagebrush. The bulk of the low growing form of sagebrush found in the Intermountain Region is one of the two subspecies of A. arbuscula. The subspecies arbuscula is the low elevation form commonly occurring below 7,000 feet in elevation. The subspecies thermopola is the high elevation form commonly occurring 7,000 feet or above in elevation. In cold mountain valleys, the thermopola subspecies may occur at low elevations. Both species occupy sites where moisture is sufficient to saturate the soil during some period of the year and prolonged dry conditions exist during other times. This condition may be produced by an impermeable soil horizon, shallow rocky soils, water table fluctuations, or periods of prolonged drought.

(c) Alkali Sagebrush. This species resembles A. arbuscula ssp. arbuscula, but flowers much earlier in the year. Alkali sagebrush occurs at intermediate elevations overlapping the ranges of the two arbuscula subspecies. It has somewhat the same habitat requirements but often occurs on soils which have more productive capability than soils on sites occupied by the other two subspecies.

These latter three low sagebrush forms are occasionally sprayed, but the response of the associated species is variable depending on the soil capability. Sites occupied by alkali sagebrush are more capable of production and responding favorably to treatment, but good results have also been obtained from spraying sites dominated by the two arbuscula subspecies as well.

Sites currently occupied by the low sagebrush groups are often important range areas for big game and sage grouse. Each site is evaluated on its own merits prior to any proposed chemical control project. Sites critical to the welfare of wildlife are not sprayed.

(2) The Big Sagebrush Group. There are four major subspecies and forms of Artemisia tridentata (big sagebrush) that occupy extensive acreage in the Intermountain Region - basin big sagebrush (Artemisia tridentata ssp. tridentata; Wyoming big sagebrush (A. tridentata ssp. wyomingensis); mountain big sagebrush (A. tridentata ssp. vaseyana) and subalpine big sagebrush (A. tridentata ssp. vaseyana form spiciformis). There are several other species and subspecies of big sagebrush that may be the target of spray operations. Only two of them occupy any large acreage in the Intermountain Region - mountain silver sagebrush (Artemisia cana ssp. viscidula) and threetip sagebrush

(A. tripartita). Each of the above mentioned subspecies has unique environmental requirements, unique combinations of associated species, and each reacts differently to grazing pressure and chemical treatment.

(a) Basin Big Sagebrush. This subspecies grows on deep well drained soils in valley bottoms and lower foothill regions. Much of its former range is now agricultural lands. Basin big sagebrush is a prime invader into meadows in valley bottoms at lower elevations. It invades these meadows following an alteration in the meadow environment through stream channel cutting and lowering of the water table. This subspecies is the least palatable of the sagebrush groups to both livestock and wildlife. It tends to increase in density and canopy coverage after spraying even when proper grazing practices are employed. Basin big sagebrush is one of the major target species for chemical control and may require additional control treatment in some areas.

(b) Wyoming Big Sagebrush. This subspecies grows in the hotter and drier portions of the Intermountain Region usually at intermediate elevations and below. It grows commonly on calcareous soils that are usually shallower than soils found on sites occupied by basin big sagebrush. Wyoming big sagebrush is considered to be the most palatable subspecies of the big sagebrush group for both livestock and wildlife. It tends to increase in density and crown cover after spraying until it reaches a crown cover of approximately 30 percent.

This density and crown cover will vary depending on site variations. With proper grazing practices, this subspecies is not expected to require respraying. The site capability of areas occupied by this subspecies is relatively low, and the response of associated species following spraying is moderate to low. Because of its low site capability and relative palatability, Wyoming big sagebrush is one of the least desirable targets for spray application and is seldom sprayed.

(c) Mountain Big Sagebrush. This subspecies occupies extensive acreage on National Forest lands. It is most common at higher elevations, but may also be found in cool environments as low as approximately 4,500 feet. Mountain big sagebrush is intermediate in palatability for wildlife and low for livestock. It has increased greatly in density and crown cover with past excessively heavy cattle grazing pressure. It is a prime invader of meadows in valley bottoms at higher elevations following an alteration of the environment of these meadows through stream channel cutting and a lowering of the water table. Mountain big sagebrush is an aggressive plant and a major target of spray operations because it has increased in density on the highly productive sites with which it is generally associated. With proper grazing practices after initial spray treatment, there are indications that some sites may and other sites may not require further treatment in subsequent years.

(d) Subalpine Big Sagebrush. This is the high elevation form of mountain big sagebrush and has most of the same characteristics. Because of the high elevation and the short growing season the response of the associated species to spraying is low. For this reason these sites are seldom sprayed.

(e) Mountain Silver Sagebrush. This species is a valley bottom species associated with meadows at elevations of about 7,000 feet or above. This is a moderately palatable species for both sheep and wildlife, particularly during the winter months. Under normal spray applications it tends to sprout vigorously within a few years after spraying, and special procedures are necessary to control it.

(f) Threetip Sagebrush. In some areas this species occupies a narrow ecological band between areas dominated by Wyoming big sagebrush and mountain big sagebrush. It is a relatively palatable species for wildlife. It tends to root sprout or establish from residual seed after spraying and may soon become as dense on the site as it was prior to spray application. For this reason this species is not a desirable target for spray application in most instances.

b. Wyethia. There are two species of wyethia in the Intermountain Region that tend to increase and become a management problem Wyethia amplexicaulis (mulesears wyethia) and W. helianthoides (whitehead wyethia). Mulesears is common throughout the Region, while whitehead wyethia is found only in certain areas.

(1) Mulesears Wyethia. Mulesears wyethia is a species of moist situations on hillsides and dry meadows, and is often associated with heavy soils within the sagebrush-grass types. It has increased with past heavy grazing, particularly by cattle, and forms almost pure stands.

(2) Whitehead Wyethia. Whitehead wyethia occurs on the more moist sites, particularly meadows. It has increased under past heavy cattle grazing pressure, and also forms almost pure stands in these situations.

Both species are low in palatability to cattle and only slightly better for sheep and big game. Occasionally blue grouse will nest where wyethia is growing. Dense stands of both species are often targets for spray applications, particularly mulesears which is more extensive and common on rangelands. During its early stages of growth, wyethia is readily eaten by deer and elk. Therefore, its importance as spring forage for big game must be taken into consideration while planning control measures.

2. Affected Birds and Mammals.

a. Birds.

(1) Sage Grouse. There are various environmental relationships that exist within the wildlife populations on a sagebrush-grassland type. The sage grouse has evolved in the sagebrush-grassland habitat and makes use of the peculiar food and cover systems provided by the various species of sagebrush and their associated species of grasses and forbs. In order to evaluate the sage grouse habitat, optimum habitat conditions must be described.

(a) Winter. During winter, nearly all of the sage grouse food and cover needs are met by sagebrush (11). Various species and densities of sagebrush are utilized depending upon the area and climate. These areas may be at high or low elevations, depending upon snow depth and its effects on available food and cover. Both big sagebrush and low sagebrush groups are utilized for food and cover requirements during the winter months. Optimum sagebrush crown canopy varies between 15 and 35 percent depending upon the site and climatic conditions.

(b) Spring and Summer. Sage grouse prefer open areas surrounded by sagebrush for strutting activities (30). During the breeding season most cocks confine themselves to a small area around their strutting grounds. All of their necessities of living must occur on these sites. Sagebrush is the primary diet of cocks during the strutting season although they also use new growth of other plants. They are dependent upon sagebrush adjacent to the strutting ground for loafing during the day. Hens use sagebrush for their primary food until more succulent food becomes available as spring advances.

The strutting ground is generally located near a suitable nesting area (44). To be most suitable for hens to nest, the area should have sagebrush of a medium height and density to provide nesting shelter (34). The height of sagebrush commonly used for nesting has been found to vary between 7 to 28 inches (18, 44, 54). Brush density preference appears to vary, but stands of about 25 percent or less canopy cover are most frequently selected (44). Average canopy density in Idaho was found to be 29 percent, with an average plant diameter of 3.3 feet based on the location of 302 nests (18). It is not clear whether the Idaho data is describing optimum conditions or actual conditions.

When the chicks hatch, they are highly dependent upon insects for food (33, 53). The optimum insect population is produced in a well balanced community of shrubs, grasses, and forbs. In most areas, sagebrush is an essential part of sage grouse brood habitat, particularly on early spring and late summer brood ranges. Scattered sagebrush with grass and forbs are utilized by broods throughout the summer for food and cover. In Montana, Wallestad found broods preferred a sagebrush crown cover of less than 25 percent with an average of 14 percent for June, 12 percent for July, 10 percent for August, and 21 percent for

September (64). In northern Nevada and southern Idaho, Phillips found the minimum to optimum sagebrush canopy requirements for summer sage grouse habitat to range between 5 and 15 percent (50). As sagebrush overstory exceeds approximately 15 percent, understory plants are suppressed and quality of the sage grouse habitat decreases (50).

As the chicks gain size and mobility, their diet shifts from insects to the buds of new leaves and flowers. During summer, chicks continue to increase the amount of vegetable food they eat, but still they require the most succulent and nutritive parts (30, 33). By summer, many grouse have been drawn into the vicinity of meadows and areas that produce succulent vegetation (53).

Where large continuous areas of dense sagebrush exist, it may be desirable to break these up by spraying narrow strips, irregular patterns, or preferably with a partial control treatment (50, 52). This will reduce the stand density to a level where sage grouse habitat is improved and succulent forage production is increased.

(c) Fall. Sage grouse dependence upon sagebrush for food increases into the fall. Grass and forbs become less necessary for food and cover after the young grouse have become fully developed and can fly a considerable distance. Succulent forbs remain in the diet as long as they are available. Dandelion, wild lettuce, alfalfa, clover, and vetches are all utilized in the diet (52).

Sage grouse have not adjusted their life processes to fit a pattern of land use, which eliminates or seriously disturbs large tracts of the sagebrush-grass types, on any of their seasonal ranges. On depleted ranges, sage grouse are dependent upon not only restoration of the grass-forb resources, but also upon restoration and preservation of some sagebrush.

(2) Sharptail grouse. Suitable habitat for sharptail grouse consists of hills or benchlands with rolling topography and slopes of less than 50 percent. The key plants for sharptail winter diet in the northern Great Basin area are buds from chokecherry, serviceberry, hawthorn, mountain mahogany, wild rose, and trees. Sunflower, wild lettuce, goatsbeard, native grasses, and grasshoppers have been observed in their summer diet. Ridgetops and knolls covered with short grass are suitable areas for dancing grounds, but they are dependent upon native grass, herbs, and shrubs nearby for feeding and roosting. Most sharptail nests are directly under or within a few feet of overhead cover. The summer brood territory consists of grasses and low shrubs. In late summer and early autumn, sharptails begin congregating into flocks of 10 to 30 birds. They occupy open cover characterized by grass, forbs, and scattered brush. As the birds develop, they tend to select the taller brush habitats. Sharptail habitat can be

sustained or improved by maintaining a high quality grassland with interspersed patches of tall brush or trees. An increasing density of sagebrush can be detrimental to sharptail grouse habitat (70).

(3) Blue and Ruffed Grouse. These two species and others are often referred to as "forest grouse." Ruffed grouse migrate relatively little during the year. They winter in low elevation conifer and deciduous timber or tall brush types. They breed and nest in open timber stands and rear broods in areas with an overstory of tall brush or trees. Only rarely are they found in sagebrush or other nontimbered areas.

Blue grouse are unique among grouse species in that they winter at high elevations, existing almost entirely on conifer needles and vegetative buds. They descend to lower elevations for breeding, nesting, and brood rearing. Breeding habitat may be associated with open timber types, tall brush types, or open areas that are closely associated with timber.

Nesting habitat for blue grouse is generally associated with herbaceous cover. However, studies now underway in northern Utah show that they also nest under shrubs (5).

Mussehl found that brood cover in the Bridger and Judith mountains of Montana was relatively uniform in physical characteristics during three seasons and on two study areas (71). He found that grass and grasslike species were consistantly most important followed closely by forbs. Brood hens were usually found where vegetation was such that hens could remain concealed except for the head and neck when standing erect. Broods were generally found within fifty yards of brush or tree cover.

(4) Songbirds. Songbirds frequently found nesting in sagebrush are the vesper and Brewer's sparrows. In sagebrush stands these birds have been reported to make up as high as 90 percent of the breeding pairs of songbirds (15). Other nongame birds frequently using the sagebrush-grassland type, but usually occurring in small numbers, are the western meadowlark, horned lark, lark bunting, mourning dove, and sage thrasher. Studies in Montana indicate that spraying of sagebrush has little if any effect on the number of breeding pairs of these species, with the exception of the Brewer's sparrow (15, 54).

The Brewer's sparrow builds its nest off the ground, usually in shrubs. Since this bird is territorial, the number of breeding pairs would be limited by the number of territories available. On an area fully stocked with Brewer's sparrows, perhaps one pair per 3 acres, a complete kill of sagebrush would possibly cause enlargement of the territory requirement, resulting in fewer breeding pairs. This reduction in breeding pairs has been found to be as high as 50 percent two years after herbicide treatment (54).

A study now underway in Utah, where 622 acres of dense wyethia and mountain big sage were sprayed in 1972, should give additional information on the effects of songbirds, insects, and blue grouse. Preliminary information shows that there were no detrimental effects resulting from use of the 2,4-D in 1972 (5). This study is being sponsored by the Utah Cooperative Wildlife Research Unit and Utah State Division of Wildlife Resources, with the Forest Service furnishing the study area and doing the 2,4-D application work. Best, 1972, reported that strip spraying of sagebrush resulted in no notable effect on vesper or Brewer's sparrows during the first year (67).

(5) Predatory Birds. Spraying sagebrush does not appear to have any significant effect on predatory birds. Reducing sagebrush canopy may temporarily expose some prey species to greater predation from raptors. Populations of various prey species will change, with some species increasing and some decreasing (28).

b. Mammals

(1) Antelope. Antelope are often yearlong residents of the sagebrush-grassland type. Their dependency on sagebrush seems to vary with the association of plants available to them. When other species of plants are available, sagebrush tends to decrease in their diet. When there is a dominance of sagebrush and lack of other browse species, antelope depend heavily on sagebrush, especially during periods when deep snow covers other forage. During the growing season antelope increase their use of forbs, grasses, and grasslike species.

On September 4, 1965, in the vicinity of Mosquito Lake, Wyoming, samples were collected from six antelope stomachs. These samples were later analyzed at Utah State University and showed species of Artemisia made up 41.1 percent by weight; total browse was 51.2 percent; forbs 41.1 percent; and grass and grasslike plants were 7.7 percent of the fall antelope diet (72). Use of forbs, grasses, and grasslike species is expected to be higher during the summer when they are more lush than the fall analysis indicates. This assumption is based on analysis obtained in eastern Wyoming by the Wyoming Game and Fish Commission (75). Their data shows the summer diet to be: browse 56.6 percent, forbs 43.0 percent, and grass 15 percent, while the fall diet was browse 79.6 percent, forbs 19.6 percent, and grass .8 percent. They also stated that big sagebrush amounted to over 19 percent of the total forage consumed (73).

During the first few weeks after birth, fawns require low scattered shrubs for cover, and in most cases sagebrush fills that need. "Grazing of antelope within the forest areas for the most part is not importance [sic] as very little grazing is realized as the result of antelope on forested lands, winter or summer, . . . ." (74). However, where antelope use occurs, their needs must be recognized. "Fawning cover in Idaho is big sage occurring in draws with an average height of 2-3 feet and approximately 30 percent canopy cover." (18).

(2) Mule Deer. Deer populations are generally limited by the quality and quantity of their winter range. With few exceptions, they depend heavily on sagebrush, especially species of the low sagebrush group. A range containing a wide variety of shrubs, forbs, and grasses would be considered higher quality than one containing only sagebrush with few associated forb and grass species.

Food habit studies conducted in Idaho show that mule deer tend to select a winter diet of about 40 to 45 percent sagebrush (26). When a variety of other palatable shrubs are available, the percentage of sagebrush in the diet tends to drop. As the variety of shrub species decreases, the percentage of sagebrush in the diet goes up (26).

In Colorado, captured deer tended to reject a straight diet of sagebrush and lost weight on the alfalfa-sagebrush diet, but readily consumed bitterbrush and mountain mahogany (13). Palatability ratings based on the amount of feed consumption ranked sagebrush below bitterbrush and mountain mahogany. The experimental deer lost weight when fed sagebrush but gained or maintained their weight when fed the other shrubs. Chemical analysis showed sagebrush to be highest in nutrients. However, the digestive process is likely to be slowed up materially when large quantities of sagebrush are consumed (43). Smith reported that when four does and two bucks were fed a choice of big sagebrush and black sagebrush, one doe refused to eat, one died, and two does ate so little they were removed from the test and put on more desirable feed (55). This inherent drawback in sagebrush results from its high level of volatile oils which inhibit the action of digestive bacteria found in the rumen. When sagebrush is consumed along with other plant species, this effect is lessened. Mule deer range must have several forage species available to be classed as high quality range.

In Utah, Plummer, et. al., stated "The goal of game range restoration is the development of a productive stand of desirable shrubs and herbs. Where some important forage plants are present, reduction of competition by appropriate methods may be all that is necessary to achieve the desired restoration. Perhaps some change in management to lessen grazing pressure would result in an adequate stand of desired species. Occasionally, spraying with a selective herbicide may be sufficient. To accomplish satisfactory improvement without seeding, at least one desirable shrub and ten desirable herbs per 100 square feet should be present." (51).

From the above it can be seen that a large acreage of dense sagebrush is, by itself, not enough to support optimum deer and other wildlife populations. A wide variety of understory species and other shrubs is also necessary. Near pure stands of sagebrush, especially those high in volatile oils, may supply an abundance of forage but, due to the volatile oil problem and lack of variety in the diet, may not provide adequate nutrition for grazing animals. Animals consuming a high percentage of sagebrush in their diet may suffer from malnutrition. In this case, reducing the density of sagebrush and replacement with other species is highly beneficial. There are instances where grazing pressure on sagebrush by deer or antelope is heavy regardless of the range quality. In such instances, reduction of sagebrush density would be detrimental to the forage supply and would result in heavier grazing on the remaining plants, possibly to the extent of their total destruction. The latter case would be termed critical game range and is not considered for chemical treatment.

(3) Elk. Elk are less dependent upon sagebrush than are deer and antelope. Elk prefer to winter in the aspen and mountain brush zones and they migrate to the lower elevation juniper and sagebrush types only when deep snow forces them to move. When elk move to these lower zones, they frequently are in direct competition with deer for forage. As soon as snow conditions permit, elk move to higher elevations making use of new growth of grass and forbs. If available, elk tend to favor tall brush types, including sagebrush, for calving but will readily use open timber types. Sagebrush is not considered to be a desirable forage species for elk but does help to supplement their diet during periods of food shortage.

(4) Bighorn Sheep. Studies have shown that the critical winter range of bighorn sheep is usually located at elevations with low snow depths and rocky cliffs for escape habitat. Desirable bighorn ranges contain mixtures of palatable browse plants, forbs, and native grasses. Native grasses, especially bunchgrasses, are probably the most important food for bighorn sheep. Browse species are important in the winter during periods of snow cover. Other plants eaten are forbs and lichens. Bluebunch wheatgrass is the most important grass in the fall-to-spring diet of most Rocky Mountain Bighorn Sheep herds.

In central Idaho, Morgan's studies showed browse usage is concentrated on mahogany (40). Only rarely do they take big sagebrush. Grasses make up an average of 69 percent of the bighorn's winter diet. On the Ashnola bighorn herd, Blood, employing grazed stem counts, analyses of rumen samples, and trailing feeding bighorns, determined that grasses made up an average of 72 percent of the fall-to-spring diet, browse 24 percent, and forbs 4 percent (9). Artemisia frigida, a nontarget species, is an important forage species on some ranges.

It appears that any management effort designed to enhance the vigor of the native grasses, especially bluebunch wheatgrass, will improve and benefit the habitat for bighorn sheep (19).

(5) Moose. Historically, moose have been associated with willow and aquatic areas. Studies within the Intermountain Region show moose inhabit spruce-fir forests, Douglas-fir forests, and various other deciduous plant habitat types as well. Moose adapt their food habits to the browse available in the various habitat types. At higher elevations low huckleberry, willow and subalpine fir are most important. At lower elevations, Douglas fir, aspen, dogwood, ceanothus, serviceberry, and chokecherry may form the bulk of the diet. Where available, single species of willow such as Salix pseudocordata is most important. The above moose habitat is not included in spray areas. It should be noted, however, that moose wander over many areas and will utilize forage found in the sagebrush-grass types (70).

## E. OTHER DEMANDS

Federal programs call for agencies to assist in rural area development. States look to Federal agencies for programs and assistance to improve the economy of rural areas. There is a constant demand for increased forage for livestock and improved habitat for wildlife. There is increasing pressure from people of the metropolitan areas to use public lands.

Regardless of the intended use of rangeland, whether it be for production of usable water, forage, wildlife, recreation, esthetics, or some combination of uses, the stress on the range environment is great. To withstand these natural and unnatural demands, the vegetation must be improved and maintained in the best possible condition.

## F. SOCIAL AND ENVIRONMENTAL OBJECTIVES

The most obvious economic benefit from treatment is an improved range condition and increased forage production. Improving range condition and forage production has a profound stabilizing effect on agricultural based communities. Ranchers are better equipped to plan long-term range management and ranch operations. A stable local economy stimulates businesses.

An increased forage supply on National Forest lands creates an atmosphere of security and encourages permittees and other landowners to develop and improve their lands. Also, livestock operations become more flexible, allowing the use of cattle as a tool to improve wildlife habitat through management. Wildlife habitat, especially for big game, is often improved by using cattle to apply grazing pressure, on a rotation basis, to grass early in the spring, thus reducing grass competition with desirable shrubs. Intensive livestock management using various forms of deferred- and rest-rotation grazing provides reserve forage and cover that wildlife may use. Herbicide can be used to improve wildlife habitat by removing brush that has invaded meadows and thinning dense stands of brush that are excess to wildlife needs.

The visual effects of herbicide application may cause alarm, depending on one's point of view. When properly handled and applied, 2,4-D is only moderately toxic. The hazard to humans, livestock, and wildlife is negligible, but may cause irritation to skin and eyes (14, 22).

## G. ECONOMIC ANALYSIS

This is a benefit-cost analysis with dollar values reduced to present worth. The costs are computed from 1972 project costs. Forage increases are computed from Intermountain Region projects done five to seven years ago. Older projects are used for production values because they have stabilized and more nearly represent forage benefits on a long-term basis. The benefit is calculated using the 1973 fair market value of $3.98 for one animal unit month (AUM). This value results from the 1966 grazing fee study adopted in 1969. The $3.98 is derived from an index of private land grazing lease rates as determined by the Economic Research Service, USDA.

| 1. Project Costs | Costs per acre |
|---|---|
| a. Planning (includes cost of field examination by professional specialists) | $ .60 |
| b. Project boundary marking | .30 |
| c. Contract preparation and administration | .05 |
| d. Spray contract (helicopter, herbicide, carrier equipment to transport material) | 4.17 |
| e. Supervision, flaggers, etc. | .30 |
| f. COR salary, per diem, and travel | .40 |
| Total per-acre cost | $ 5.82 |

a. Planning would include the preparation of the environmental analysis, the time spent by specialists, such as wildlife biologists in determining effect of the project on wildlife species, or landscape architects in suggesting patterns of treatment of an area to break up solid patches of continuous sagebrush, range scientists or plant ecologists to assess the vegetative aspects of treatment, and soil scientists to evaluate soil characteristics.

b. Actual marking project boundary with paper or flagging and removal of the same after project is completed.

c. Preparation of the contract, advertising, administration of contract after bid has been accepted. Designation of COR for contract administration and making payments.

d. Materials included in the contract are herbicide, carrier, inverting agent, and transportation of this material to actual project site. The contractor also furnishes helicopter, pilot, mechanic, gas for helicopter and other vehicles, pump for loading herbicide mixture from mixing tanks to helicopter, and manpower to do the same (this cost is based on the 1972 bid price).

e. The National Forest or Ranger District must have one person who is familiar with the area to be treated. This individual identifies boundary and areas of particular concern to COR and pilot. If flaggers are needed on the project they are also furnished by the Ranger District or National Forest.

f. The contracting officer's representative is an individual that has been specially trained in contract administration, in handling, and application of herbicides. He is the individual that determines with the pilot when and how the job is to be done. The pilot is responsible for the safety of the helicopter and himself.

There has been no cost included for loss of forage to livestock because nearly all treatment areas are in the rest or deferred unit of an allotment that is being managed intensively. An adjustment in usable forage is made to account for the rest period.

2. Project Economic Returns. Analysis of increased grass production on 17 five- to seven-year old projects in the Intermountain Region shows that annual production of grass increased an average of 845 pounds dry weight per acre. Research has shown similar results in other areas. Assuming 60 percent of this increase will be used for watershed protection, benefits to soil, plant vigor, and esthetics, then the remaining 40 percent of the increase is available for livestock and wildlife use. To arrive at dollar values, we have converted this available increased forage production to .37 AUM's per acre.* This increase in production will last an average of more than 20 years. There is a period toward the end of this cycle when production may taper off, as a balance between target species and other perennial vegetation is reached. We have used a 20-year expectancy for the purpose of analysis only. This is not intended to imply that forage production will drop to the level it was before treatment.

The annual economic return from usable forage is $1.47 per acre. This is arrived at by multiplying the 0.37 AUM's per acre increase by the $3.98 fair market value of one AUM.

*845 lbs. x .40 = 338 lbs. 338 lbs. ÷ 900 lbs. (cow and calf need per month) = .37 AUM's per acre.

The present value of a $1.00 annual income extending over a period of 20 years at an interest rate of 10 percent, compound interest premise, where payments are received at the beginning of the year amounts to $8.513

Multiplying the annual economic return of $1.47 times 8.513 (the present worth of expected future incomes) gives an expected economic benefit from forage of $12.51 per acre treated.

3. Benefit-Cost Ratio. The calculated benefit-cost ratio to the national economy over a 20-year period would be $\frac{\$12.51}{\$\ 5.82} = 2.15$. That is, for every $1.00 expended, the economy would benefit in the amount $2.15 from increased grass production available for use as forage.

4. Other Benefits Not Calculated. The predicted amount of usable forage has been evaluated on the basis of its worth as forage for cattle. In reality, a forage allowance is made for use by wildlife to the extent that they may be able to take advantage of additional forage production. Frequently, there are other factors limiting increased use by wildlife such as a shortage of winter range. In Nevada, Savage pointed out that increasing the amount of succulent vegetation for use by sage grouse during the summer would be of considerable benefit (53). Just what effect the total program actually has on a state-wide sage grouse population is uncertain. There is little question that there are a vast number of factors involved. Most states in the Intermountain Region have reported a general overall increase in sage grouse since 1965 (44).

When data is available, benefit values to game species are often calculated on the basis of increased hunter days created. A hunter day is calculated by the Forest Service as having a value of $6.00.

Values accredited to soil stabilization are based on the value of retaining soil on site and downstream values that may be damaged as a result of erosion. The value of retaining soil in place in the Sevier River Basin of Utah was set at $0.30 per cubic yard (62).

5. Alternative Cost Comparisons. Comparative project costs between chemical, prescribed burning, chaining, and plowing treatments are provided in the following tables: See Section V for discussion of alternatives.

| a. Prescribed Burning | Cost per acre |
|---|---|
| (1) Planning (includes cost of field examination by professional specialists) | $ .75 |
| (2) Project boundary marking and mapping | .30 |
| (3) Fireline preparation control costs (highly variable) | 2.00 |
| (4) Seeding costs when applicable (aerial application) | (5.00) |

a. Prescribed Burning (cont.)

| | | Cost per acre |
|---|---|---|
| (5) | Supervision and labor | $ .85 |
| (6) | Equipment costs (trucks, torches and fuel) | .10 |
| | Subtotal | $ 4.00 |
| (7) | Burning requires nonuse of the entire pasture or unit prior to burning in order to furnish dry grass to help spread fire. This value is highly variable and may average $2 per acre actually burned. | 2.00 |
| | Total project cost an acre without seeding | $ 6.00 |

Forage gained is approximately the same as for chemical treatment - .37 AUM's per acre.

b. Chaining or Railing

| | | |
|---|---|---|
| (1) | Planning (includes cost of field examination by professional specialists) | $ .45 |
| (2) | Project boundary marking and mapping (includes marking and protecting land survey markers) | .45 |
| (3) | Seeding costs when applicable (aerial application) | (5.00) |
| (4) | Contracting and tractor rental (twice-over chaining) | 6.00 |
| (5) | Equipment costs (trucks, chain repair, etc.) | .60 |
| (6) | Supervision and labor | 1.00 |
| | Subtotal | $ 8.50 |
| (7) | No grazing loss during treatment if seeding is not employed (planned rest grazing system employed). When seeding is employed benefits are delayed two years and nonuse of the unit is necessary. | |
| | Total project cost per acre without seeding | $ 8.50 |

Forage increase resulting from a chaining project is usually less than for chemical control because sagebrush control is less, thus more competition to forage species. Annual net usable forage gained from chaining sagebrush averages .3 AUM's per acre.

c. Plowing and Seeding (one recent project)

| | Cost per acre |
|---|---|
| (1) Planning (includes cost of field examination by professional specialists) | $ .55 |
| (2) Project boundary marking and mapping (includes marking and protecting land survey markers) | .45 |
| (3) Seeding costs (seed drilled in) | 7.00 |
| (4) Contracting and equipment rental | 10.00 |
| (5) Equipment costs (trucks, plows, and drills) | 1.00 |
| (6) Supervision and labor | 2.00 |
| Subtotal | $ 21.00 |
| (7) Grazing lost during treatment period due to additional rest (highly variable) | 1.42 |
| Total project cost per acre includes seeding | $ 22.42 |

Net benefits are delayed at least two years after treatment. Expected annual increase in net usable forage is .3 to .4 AUM's per acre.

H. SIZE OF ANNUAL HERBICIDE PROGRAM

In the past five years an annual average of slightly less than 2,000 acres have been treated by the Forest Service in western Wyoming. This average is not expected to increase.

The planning and environmental analysis made on each project area materially reduces the acreage that can be sprayed. Consequently, spray areas are in small blocks; they are irregular in shape and intermingled with numerous strips and patches not receiving treatment. See Figure 2 for example of typical project area and general spray area. It should be noted that additional control is placed on the ground at the time of actual spray application to avoid spraying water areas and nontarget vegetation.

I. LANDOWNERSHIP AND STATUS

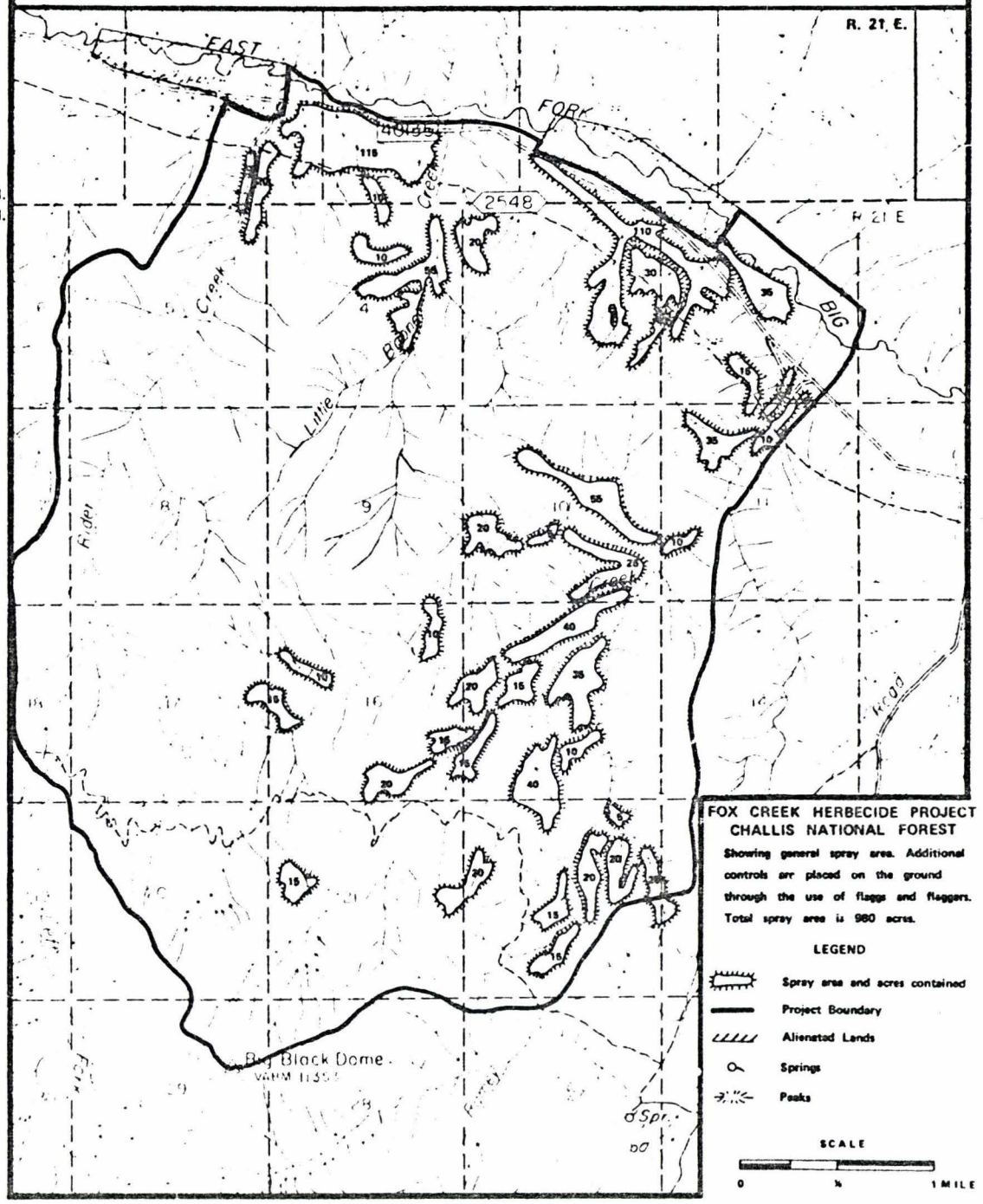
All lands involved are Federally owned and are administered by the Intermountain Region, Forest Service, U.S. Department of Agriculture.

J. PHYSIOGRAPHY AND CLIMATE

The National Forest lands of the Intermountain Region are involved. They are drained by the Snake, Green, Bear, and Sweetwater Rivers.

FIGURE NO. 2

Typical project area showing design and size of spray areas. Due to map scale it is not always possible to show leave strips along streams and other sensitive areas. Additional control using flags or men holding flags are placed on the ground.




R. 21 E.

The project areas are in mountainous terrain except for some minor foothill areas. Elevations vary from 4,500 to 10,000 feet. Annual precipitation varies from 10 to approximately 25 inches. Most precipitation comes during the winter in the form of snow. Summer precipitation is frequently in the form of thundershowers. Mean annual temperatures vary between 37° and 52° Fahrenheit.

## K. SUBSEQUENT MANAGEMENT

Treated areas are generally part of the grazing allotment. On such allotments a spray project cannot be approved unless the grazing allotment management plan provides for intensive management after treatment. The number of growing seasons that a spray area is rested from livestock grazing depends on its condition classification. In all cases it is rested the year the project is done. Some form of planned-rest management is practiced on the grazing allotment. The spray project is planned to be done the same year this portion of the allotment is scheduled for rest. If more rest is needed, the grazing sequence is repeated the following year. This management system does not require permittees to reduce permitted livestock use as a result of the spray project. Regardless of whether an area receives chemical or mechanical treatment or not, grazing must be kept in balance with forage supply and be compatible with other values as directed by the Multiple Use and Sustained Yield Act.

## L. HISTORY OF PROGRAM

Herbicide use on National Forest rangeland started in about 1946 with test areas and trials on small acreages. First tests were done with backpack sprayers and farm sprayers. Considerable interest among land administering agencies and universities developed in the late 1940's and early 1950's. Tests were made to determine kinds and amount of herbicides to use, timing of application, and evaluation of results. It was generally concluded that two pounds active ingredient of 2,4-D per acre gave best results per dollar cost, even though lighter rates gave some control (8, 16, 25, 42).

When range scientists were convinced that herbicides were useful tools, larger acreages were sprayed using fixed-wing aircraft. By about 1960, it was recognized that applications by fixed wing aircraft gave some undesirable results that needed correcting. This method lacked needed control of application, resulting in nontarget vegetation types being affected. The large block type treatment was found to have some undesirable impacts on wildlife habitat, especially sage grouse.

In the early 1960's helicopters were employed for herbicide application. These machines provided excellent control. They made it possible to develop meandering irregular patterns and to avoid spraying nontarget areas.

Spray drift and volatilization have often been a problem when spray areas were closely associated with critical areas such as water and nontarget vegetation. Emulsifying and inverting additives have largely eliminated this problem. Considerable difficulty in using these additives was encountered at first. Inverting agents have since been developed that do an excellent job of control but still cause some handling problems. Most problems encountered are mechanical. Even though application techniques have developed to a fine art and undesirable effects of herbicide use can largely be eliminated, success of the program is still dependent on the personnel who plan and carry out the program.

Today, efforts are being directed away from obtaining maximum kill of target species and toward applying only the control necessary to upgrade the usefulness of the sagebrush ecosystem.

## II. ENVIRONMENTAL IMPACTS

### A. AIR

There will be a minor introduction of 2,4-D into the air during and immediately after application. This cannot be seen but the smell of 2,4-D is noticeable for a few days. The use of an invert emulsion reduces the possibility of the carrier evaporating away from the herbicide leaving minute particles floating in the air.

### B. SOIL

Studies have shown that 2,4-D degradation in forest litter is about 85 to 90 percent after 13 days when applied at two pounds acid equivalent per acre (45, 46). Esters of 2,4-D are not considered to be persistent in the soil. Soil micro-organisms readily break the chemical down. The residence time for 2,4-D used for sagebrush control is, at most, about four weeks (22). Test applications during the growing season of 20 pounds per acre usually disappear in two months (22).

Soil moisture conditions and temperature in the sagebrush areas are somewhat dryer and perhaps a little cooler than where the western Oregon studies were conducted. However, 2,4-D is applied in the spring (May 15 to July 5) when soil moisture and temperature are high enough to provide for active growth of the target species, so degradation of 2,4-D should approximate both the eastern and western Oregon studies.

Soil compaction resulting from equipment during application is minimal. Post project evaluations have not shown damage to the soil.

### C. VEGETATION

Degradation of 2,4-D in plants has been found to reach 85 percent in 13 days following application (45). The greatest impact results from injuring or killing some plants susceptible to 2,4-D.

1. Sagebrush. Percent mortality of sagebrush depends on the species, subspecies, soil moisture, and stage of growth of the plant (16, 42). Projects normally range from 60 to 95 percent mortality. Frequently seedlings escape injury because of protection from overstory plants. Conventional methods of application using three gallons diesel and two pounds of 2,4-D (acid equivalent) per acre generally give mortality near 90 percent (8). Newer methods and lighter concentrations of 2,4-D being used indicate that mortality can be reduced to a more optimum level of 70 percent.

2. Grass. Grass is not affected by 2,4-D in the concentration used. Consequently, grass may increase rapidly and compete with other desirable vegetation. Under some circumstances, special management of cattle is necessary to apply grazing pressure to grass, thus releasing space and soil moisture to forbs, bitterbrush, and similar shrubs.

3. Forbs. Many forb species will be affected by 2,4-D while others will not. Frequently the number of individual plants are reduced, especially annuals. Some forbs have the aerial portion damaged but root sprout the following year. Many forbs are early spring or summer growers and are not significantly affected by 2,4-D because of their season of growth. Table 1 shows the relative susceptibility of various forb species one to three years after treatment with 2,4-D as evaluated by Blaisdell and Mueggler (8). Table 2 shows production of species before treatment and three years after treatment as reported by Mueggler and Blaisdell (41). These data show a 29 percent increase of forbs on the sprayed area. This increase is probably a result of weather and measurement factors and not an actual increase resulting from the spray treatment. Forb increase on the burned and railed areas was much higher than on the sprayed area. These data also show that species of the genus Lupinus are greatly reduced the first few years after treatment with 2,4-D.

"In extensive spraying in Wyoming, Hull and Vaughn found mainly top kill of species associated with sagebrush. The only permanent effect was a heavy kill on phlox and a 20% kill on rabbitbrush" (24). Also see Hull, A. C. Jr. et al (25). In Wyoming on two study sites on the Gros Ventre River drainage where 2,4-D was used, it was found that forb production remained fairly stable on one site on treated and untreated plots, and the other site produced 584 pounds of forbs (air dry) on the treated plot compared to 562 pounds on the untreated plot (65).

Analysis of data on 17 five- to seven-year old Intermountain Region projects shows forbs decreased an average of 17 pounds per acre after treatment. Forbs increased on four projects and showed a significant decrease on two projects. Wyethia and Lupinus species accounted for most of the decrease. On poor condition ranges many least desirable forbs have increased beyond their natural abundance. These plants decrease in number as ranges improve regardless of whether herbicide is applied or not.

4. Shrubs. Table 1 shows the relative susceptibility of most shrubs found associated with spray areas (8). One common species not mentioned is Cercocarpus montanus. This species is defoliated by 2,4-D but the roots sprout. Any time either Cercocarpus or Amelanchier species occur with significant density, the area is not sprayed. Occasionally Amelanchier occurs as old decadent plants, and 2,4-D defoliates the aerial portion and usually induces root sprouting. However, recovery following treatment is slow. Other susceptible shrubs in Table 1 are nontarget species and are not commonly found within spray areas. Bitterbursh, Purshia tridentata, a very desirable shrub, will increase after reduction of sagebrush competition if the site is favorable and big game grazing is not excessive. One study in Idaho showed 60 percent more Purshia on treated areas as opposed to untreated after three years (41). Results similar to this have been obtained on several National Forests.

TABLE 1. MORTALITY OF PLANTS ON AREAS SPRAYED WITH 2,4-D TO CONTROL BIG SAGEBRUSH[1/]

| Species | Mortality[2/] |
|---|---|
| **Shrubs and Trees** | |
| Amelanchier alnifolia | Heavy |
| Artemisia cana | Moderate |
| Artemisia tripartita | Heavy |
| Ceanothus velutinus | Unharmed[3/] |
| Pinus contorta | Light |
| Populus tremuloides | Light[3/] |
| Potentilla fruticosa | Unharmed |
| Prunus virginiana | Light[3/] |
| Pseudotsuga menziesii | Unharmed |
| Purshia tridentata | Light |
| Salix spp. | Light[3/] |
| Symphoricarpos oreophilus | Light[3/] |
| Tetradymia canescens inermis | Unharmed |
| **Forbs** | |
| Achillea millefolium | Unharmed |
| Agastache urticifolia | Light |
| Agoseris spp. | Moderate |
| Antennaria microphylla | Light |
| Aplopappus sp. | Unharmed |
| Arnica fulgens | Light |
| Astragalus convallarius | Unharmed |
| Astragalus miser praeteritus | Unharmed |
| Astragalus salinus | Unharmed |
| Astragalus stenophyllus | Heavy |
| Balsamorhiza sagittata | Heavy |
| **Forbs (Cont.)** | |
| Calochortus macrocarpus | Unharmed |
| Castilleja spp. | Heavy |
| Comandra umbellata | Light |
| Crepis acuminata | Unharmed |
| Delphinium depauperatum | Unharmed |
| Delphinium glaucescens | Unharmed |
| Erigeron corymbosus | Light |
| Eriogonum heracleoides | Light |
| Eriogonum ovalifolium | Unharmed |
| Geranium viscosissimum | Unharmed |
| Helianthella uniflora | Heavy |
| Linum lewisii | Unharmed |
| Lithospermum ruderale | Moderate |
| Lupinus caudatus | Heavy |
| Lupinus leucophyllus | Moderate |
| Mertensia oblongifolia | Heavy |
| Opuntia polyacantha | Unharmed |
| Penstemon radicosus | Light |
| Penstemon spp. | Heavy |
| Perideridia gairdneri | Unharmed |
| Phlox canescens | Light |
| Potentilla spp. | Heavy |
| Rumex sp. | Unharmed |
| Senecio integerrimus | Light |
| Geun triflorum | Heavy |
| Solidago sp. | Unharmed |
| Viola spp. | Unharmed |
| Zigadenus paniculatus | Heavy |

1/Blaisdell, J. P. and Mueggler, W. F., 1956. Effects of 2,4-D on Forbs and Shrubs Associated with Big Sagebrush. Journal of Range Management, 9:38-40.

2/Ratings: Unharmed, light, 1 to 33 percent kill; moderate, 34 to 66 percent kill; heavy, 67 to 100 percent kill.

3/Severe damage to aerial portions, but few plants completely killed--almost all sprouted profusely.

Table 2 - Herbage Production Before Treatment (1952) and After Treatment (1955) On Comparable Areas Subjected to Different Methods of Treatment.

| Species | Burned | | Sprayed | | Railed | |
|---|---|---|---|---|---|---|
| | 1952 | 1955 | 1952 | 1955 | 1952 | 1955 |
| | (Airdry pounds per acre) | | | | | |
| Total Grass* | 229 | 295 | 245 | 430 | 200 | 310 |
| Total Forbs | 82 | 307 | 65 | 92 | 80 | 223 |
| Total Shrubs | 361 | 137 | 281 | 219 | 267 | 184 |
| TOTAL PRODUCTION | 672 | 739 | 591 | 741 | 547 | 717 |
| (Forbs) | | | | | | |
| Achillea lanulosa | 3 | 9 | - | Trace | - | 1 |
| Antennaria microphylla | 4 | 4 | 5 | 18 | 7 | 39 |
| Arnica fulgens | 1 | 2 | 5 | 6 | 23 | 20 |
| Astragalus miser | - | 3 | Trace | 4 | 1 | 6 |
| Astragalus convallarius | - | 10 | - | 2 | - | 4 |
| Comandra umbellata | 3 | 2 | 5 | 3 | 1 | 1 |
| Erigeron corymbosus | 9 | 38 | 14 | 13 | 21 | 44 |
| Eriogonum heracleoides | 8 | 13 | 8 | 17 | 2 | 10 |
| Lupinus spp. | 41 | 148 | 15 | 4 | 6 | 51 |
| Penstemon radicosus | 5 | 3 | 5 | 7 | 5 | 9 |
| (Shrubs) | | | | | | |
| Artemisia tridentata | 337 | 47 | 269 | 178 | 257 | 144 |
| Chrysothamnus puberulus | 5 | 68 | 3 | 12 | 3 | 20 |
| Purshia tridentata | 14 | Trace | 5 | 13 | - | - |
| Tetradymia canescens | 5 | 21 | 4 | 17 | 6 | 20 |
| Others | 8 | 79 | 8 | 18 | 15 | 38 |

*Grass species were not separated in the 1952 survey.

Taken from Mueggler and Blaisdell (41).

5. Trees. Pine species are susceptible to 2,4-D and diesel oil and are often injured if sprayed. Aspen trees generally lose their canopy but roots sprout profusely. Spruce and fir trees are generally resistant to 2,4-D. Trees are not included within spray areas unless they occur as scattered individuals.

6. Aquatic Vegetation. There will be no impact on aquatic vegetation unless some accident should happen, such as a helicopter loaded with 2,4-D crashing into the water. In this case damage to aquatic life would occur. Water areas are not sprayed and a minimum 100-foot or larger buffer strip is left untreated next to streams, ponds, and lakes.

D. WATER

Even though water is not sprayed and buffer strips are provided, it is possible for minute amounts of chemical to enter live streams. When herbicide is applied at a rate of two pounds, a.i., per acre directly to water, concentrations of .7 ppm (parts per million) can be expected in 12 inches of still water (22). In seven years of monitoring spray operations in Oregon, scientists have never found residues exceeding 1.0 ppm, and residues seldom exceeded .1 ppm when streams flowed through spray areas. Concentrations seldom exceeded .01 ppm when streams flowed adjacent to treated areas (46). Projects being proposed here will use herbicide concentrations lower than those used in collecting the above data and streams will not be included in the spray areas. Buffer strips of more than 100 feet are always required and application when wind is away from streams is the general practice.

Phenoxy chemicals entering water may be lost by volatilization, absorption on sediments, absorption by aquatic biota, by chemical degradation, and most importantly, by dilution as additional stream water passes down the channel. Almost all authorities agree that there is considerable absorption of herbicides on sediments (2, 7).

The hazard of herbicides in water depends on the toxicity and concentration of the herbicide. There are two kinds of toxicity - acute and chronic (see Tables 3 and 4). Acute toxicity is exposure to relatively large doses for a few hours to a few days, and chronic toxicity is exposure to relatively low levels for longer periods of time. Normally, acute toxicity is of most concern. The toxicity, as determined in the laboratory using pure water, may be more toxic to aquatic biota than under field conditions because of losses previously outlined. The State of California, citing results obtained from many studies, stated that tomatoes were irrigated with tap water containing 20 mg/l (approximately 20 ppm) of 2,4-D. In most instances the tomatoes were more vigorous than when treated with straight tap water. Cotton was treated in a similar manner with 11 mg/l (11 ppm) with similar results (38).

Studies at the San Dimas Experimental Forest in California showed that 2,4-D and 2,4,5-T used for vegetation type conversion did not impair streamflow quality (36). Researchers found herbicide content of water samples was well below what they considered the safe limit of 1 ppm. Stream samples contained a maximum of .05 ppm and shallow well samples contained a maximum of .04 ppm.

There are conflicting opinions as to the amount of increased infiltration resulting from spray projects. Soil types, topography, and land management after application have significant influence on infiltration. On many project areas overland flow has become insufficient to provide enough water for storage in ponds previously used to collect overland flow for livestock use. This indicates that infiltration has increased. Studies in Wyoming show that sprayed sagebrush areas retain more snow and have a higher soil moisture level than untreated areas (1).

In a six-year study on the Curlew National Grassland, Hull and Klomp found that big sagebrush intercepted 30 percent of the rain and 37 percent of the snow. This intercepted moisture evaporated into the air and did not recharge the soil moisture supply; hence, there was less soil moisture available for vegetation production than where sagebrush was controlled (24).

In a one-year study at 9,500 feet elevation near Dubois, Wyoming, Hutchison found that some snow persisted on a sagebrush site between sagebrush plants for a short while after it had disappeared from a natural grass type (27).

## E. ESTHETICS

There is considerable change in appearance of treated areas in contrast to nontreated areas. Untreated areas have a visual dominance of sagebrush while treated areas usually have a visual dominance of grass and dead brush. After a number of years (5 to 10) the dead brush is usually broken down and the remaining live sagebrush and new sagebrush tends to neutralize the contrast with untreated areas. If the dead sagebrush stalks are objectionable, they can be eliminated by dragging a roller or an anchor chain over the area.

## F. SOUNDS AND SMELL

A person familiar with the smell of 2,4-D will notice its presence for a few days after application. Depending on one's point of view, this smell may or may not be objectionable. In either case the smell is not strong.

About the only unusual sound involved is the noise caused by the helicopter. Because of wind and temperature restrictions, most flying is done from daylight until about 10:00 a.m. On occasions some flying is done at dusk.

## G. HUMAN HEALTH

Spectators are not allowed on the project area during application. The only known hazard is to workers handling the chemical. Precautions are taken to minimize this hazard by regular change of clothing and frequent washing with soap and water.

## H. ANIMALS, BIRDS, AND INVERTEBRATES

Numerous studies have been reported in relation to toxicity of 2,4-D and other herbicides. In general, all report essentially the same results noted by House et al (22). "We conclude that the risk of human and animal toxicity from the use of 2,4-D and its various esters and salts is very very low." This same paper cites studies where 2,4-D dust applied directly to honey bees and also placed in the hive entrance did not adversely affect adult bees nor the brood. There have been cases where cattle were poisoned from eating plants high in nitrate. It has been suggested that 2,4-D may make the plants more palatable. This is not considered a problem on National Forest lands. Furthermore, treated areas are not grazed by livestock the season of treatment.

Studies have been conducted where 2,4-D was fed to dairy cows and steers. The 2,4-D was found unchanged in the urine only. No evidence of metaoxidation was found (3, 4, 20, 21, 37). Similar findings were obtained with sheep. Ninety-six percent of an orally administered dose of 2,4-D-C-$^{14}$ to a sheep was excreted unchanged in the urine in seventy-two hours and slightly less than 1.4% in the feces (68).

In rats receiving 1 to 10 mg. of 2,4-D, there was almost complete excretion of the chemical in the urine and feces in 48 hours. At higher dosage levels, some accumulation in tissues occurred. Analysis also indicated that traces of an unidentified metabolite appeared in the urine (32). The studies with presently available commercial formulations of 2,4,5-T and 2,4-D show no teratogenic effects in rats at rates up to 50 mg/kg/day and 87.5 mg/kg/day respectively. Some fetal resorptions appear at higher levels according to Johnson's summary of a variety of tests for teratogenicity (29). See Tables 3 and 4.

Kopischke described an experiment where fertile pheasant and bantam chicken eggs were sprayed to the point that solutions dripped off on the 13th day of incubation (35). The three solutions used were water, isooctyl ester of 2,4-D and water, and straight diesel fuel (the chicken eggs did not receive the diesel treatment). Eggs were then placed back in an incubator for completion of the incubation period. Table 5 summarizes hatch results of this experiment. Three hatched pheasants were deformed - one in the 2,4-D group and two in the water only group. No hatched chickens were deformed. It should be pointed out that spraying eggs to the point that the solutions dripped from them would be many times the amount used on Forest Service projects.

Table 3 - CHRONIC TOXICITY OF 2,4-D

| Formulation | Organism | Dose | Duration | Effect | Reference |
|---|---|---|---|---|---|
| Triethanolamine | Swine | 50/mg/kg/day | 8-10 doses | Minor transient effects. | (a) |
| Butyl ester | Swine | 50/mg/kg/day | 5 doses | None | (a) |
| Triethanolamine | Swine | 500 ppm in feed | 1 month | Some locomotory disturbance, depressed growth rate, no gross pathology | (a) |
| Triethanolamine | Rats | 1000 ppm in water | 10 mos. | Depressed growth rate, no gross pathology | (a) |
| Triethanolamine | Chicken | 1000 ppm in water | Daily from hatching through first 2 mos. of egg production. | Egg size normal, production reduced 30%. | (a) |
| Not specified | Dog | 500 ppm in feed | 2 years | None | (b) |
| Not specified | Rat | 1250 ppm in feed | 2 years | No effects on growth, survival hermatology or tumor incidence. | (b) |
| Not specified | Rat | 500 ppm in feed | 2 years | No effects in reproduction studies. | (b) |

Table 3 - CHRONIC TOXICITY OF 2,4-D (Cont.)

| Formulation | Organism | Dose | Duration | Effect | Reference |
|---|---|---|---|---|---|
| Ethylhexyl ester | Cattle | 250/mg/kg/day | 14 days | Sick in 3 days, survive & recover from 9 doses. 14 doses lethal. | (c) |
| Ethylhexyl ester | Sheep | 250/mg/kg/day | 17 days | Sick in 3 days - 17 doses lethal. | (c) |
| Ethylhexyl ester | Sheep & Cattle | 100/mg/kg/day | 10 days | None to minor effects | (c) |
| 2,4-D in water | Human taste threshold | .01mg/l* | | Bad taste | (d) |
| Alkanolamine | Sheep | 100/mg/kg/day | 481 days | No effect | (e) |
| Alkanolamine | Cattle | 50/mg/kg/day | 112 days | No effect | (e) |
| Propylene glycol butal ether ester | Sheep | 100/mg/kg/day | 481 days | No effect | (e) |
| Alkanolamine | Chicken | 100/mg/kg/day | 10 days | No effect on weight gain | (f) |
| Propylene glycol butal ether ester | Chicken | 50 mg/kg/day | 10 days | No effect on weight gain | (f) |
| Propylene glycol butal ether ester | Cattle | 100mg/kg/day | 10 days | No effect | (f) |
| Acid | Mule deer | 80 & 240mg/kg/day | 30 days | Minor symptoms - no weight loss | (g) |

*mg/l is approximately the same as ppm.

Literature Cited - Table 3

(a) Bjorkland, Nels., and Erne, K. - 1966
Toxicological Studies of Phenoxyacetic Herbicide in Animals
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The Toxicity of Some Organic Herbicides to Cattle, Sheep and Chickens. Production Research Report No. 106 - ARS - USDA.

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U.S. Dept. of Interior.

Table 4 - ACUTE TOXICITY OF 2,4-D

| Formulation | Organism | Dose | Effect | Reference |
|---|---|---|---|---|
| Triethanolamine | Swine | 50 mg/kg | No effect | (a) |
| Triethanolamine | Swine | 500 mg/kg | Lethal | (a) |
| Butyl ester | Swine | 100 mg/kg | No effect | (a) |
| Triethanolamine | Chicken | 300 mg/kg | No effect | (a) |
| Butoxyethanol ester | Phytoplankton | 1 ppm | 16% decrease in $CO_2$ fixation | (b) |
| Dimethylamine | Phytoplankton | 1 ppm (4 hrs) | No effect on $CO_2$ fixation | (b) |
| Ethylhexyl ester | Phytoplankton | 1 ppm (4 hrs) | 39% decrease in $CO_2$ fixation | (b) |
| Propylene glycol butyl ether ester | Phytoplankton | 1 ppm (4 hrs) | 44% decrease in $CO_2$ fixation | (b) |
| Butyl ester | Rats | 620 mg/kg | $LD_{50}$ | (c) |
| Unspecified | Trout | 3 mg/l* | Lethal 24 hrs | (d) |
| Unspecified | Trout | 2.2 mg/l* | Lethal 48 hrs | (d) |
| Unspecified | Man | 689 mg/kg | Lethal | (d) |

* mg/l is approximately the same as ppm.

Table 4 - ACUTE TOXICITY OF 2,4-D (Cont.)

| Formulation | Organism | Dose | Effect | Reference |
|---|---|---|---|---|
| Isopropyl ester | Rats | 700 mg/kg | $LD_{50}$ | (e) |
| Propylene glycol butyl ether ester | Bluegill | 3 ppm | 48 hr TLm | (f) |
| Alkanolamine | Bluegill | 435 ppm | 48 hr TLm | (g) |
| Isooctyl ester | Bluegill | 9 ppm | 48 hr TLm | (g) |
| Butyl ester | Bluegill | 1 ppm | 48 hr TLm | (g) |
| Isopropyl ester | Bluegill | 1 ppm | 48 hr TLm | (g) |
| Dimethylamine | Bluegill | 166 ppm | 48 hr TLm | (g) |
| Alkanolamine | Chicks | 380-765 mg/kg | $LD_{50}$ | (h) |
| Isopropyl ester | Rats | 700 mg/kg | $LD_{50}$ | (h) |
| Isopropyl ester | Chicks | 1420 mg/kg | $LD_{50}$ | (h) |
| Isopropyl ester | Guinea pigs | 550 mg/kg | $LD_{50}$ | (h) |
| Butyl ester | Rats | 620 mg/kg | $LD_{50}$ | (h) |
| Butyl ester | Guinea pigs | 848 mg/kg | $LD_{50}$ | (h) |
| Butyl ester | Chicks | 2000 mg/kg | $LD_{50}$ | (h) |
| Propylene glycol butyl ether ester | Rats | 570 mg/kg | $LD_{50}$ | (h) |

Table 4 - ACUTE TOXICITY OF 2,4-D (Cont.)

| Formulation | Organism | Dose | Effect | Reference |
|---|---|---|---|---|
| Acid | Dogs | 100 mg/kg | $LD_{50}$ | (h) |
| Acid | Chicks | 541 mg/kg | $LD_{50}$ | (h) |
| Unspecified amine | Mallard ducks | 2000 mg/kg | $LD_{50}$ | (i) |
| Acid | Pheasants | 472 mg/kg | $LD_{50}$ | (i) |
| Acid | Mule deer | 400-800 mg/kg | $LD_{50}$ | (i) |

Literature Cited - Table 4


(a) Bjorkland, Nels., and Erne, K. - 1966
Toxicological Studies of Phenoxyacetic Herbicide in Animals
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Associated with Their Use. Am. J. Vet. Res. 15: 622-629.

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Table 5 - Hatching Results of Pheasant and Chicken Eggs Treated With Water (Control), 2,4-D Solution, and Diesel Fuel

From Kopischke 1972 (35).

| | Treatment | | | | | |
|---|---|---|---|---|---|---|
| | Water | | 2,4-D | | Diesel Fuel | |
| | Number | Percent | Number | Percent | Number | Percent |
| PHEASANT EGGS | | | | | | |
| Hatched | 25 | 44 | 29 | 51 | 0 | 0 |
| Not Hatched | 32 | 56 | 28 | 49 | 57 | 100 |
| Total | 57 | 100 | 57 | 100 | 57 | 100 |
| CHICKEN EGGS | | | | | | |
| Hatched | 18 | 29 | 21 | 34 | - | - |
| Not Hatched | 44 | 71 | 41 | 66 | - | - |
| Total | 62 | 100 | 62 | 100 | - | - |

TABLE 6 AVERAGE NUMBERS OF BOTTOM ORGANISMS PER SQUARE FOOT FOLLOWING APPLICATION OF 2,4-D RANGING FROM ONE TO FOUR PPMW IN SIX PLASTIC ENCLOSURES, 1958-1959

| Taxonomic Group | Control | One Week | Six Weeks | 12 Months |
|---|---|---|---|---|
| Mayfly nymphs | 4.00 | 0.17 | 0.17 | -- |
| Horsefly larvae | 12.44 | 4.50 | 4.50 | 3.67 |
| Common midges | 17.11 | 4.50 | 1.50 | 0.33 |
| Mosquitoes | 0.44 | 0.33 | -- | -- |
| Phantom midges | 3.00 | 1.00 | 3.33 | 0.33 |
| Biting midges | 1.22 | 0.33 | 0.50 | -- |
| Caddis fly larvae | 2.78 | 1.33 | 0.17 | 0.33 |
| Damselfly nymphs | 0.22 | 0.17 | -- | 0.67 |
| Water beetles | 0.02 | -- | 0.17 | 3.33 |
| Aquatic worms | 24.11 | 10.00 | 4.50 | 1.67 |
| Leeches | 0.11 | -- | -- | -- |
| Clams | 5.44 | -- | -- | -- |
| Snails | 5.67 | 0.50 | -- | -- |
| Total Numbers | 76.56 | 22.83 | 14.83 | 10.33 |
| Total Weight | 1.299 | 0.733 | 0.175 | 0.127 |

Source: C. A. Walker, (1962) Toxicological effects of herbicide on the fish environment. Missouri University Engineering Extension series 2. Proceedings of the 8th Annual Air and Water Pollution Conference 1962, pp. 17-34.

The effect of 2,4-D on aquatic bottom-feeding fishfood organisms is shown in Table 6. It appears that concentrations of 1.0 to 4.0 ppm of 2,4-D gives about 44 percent reduction in weight in one week. It should be borne in mind that these data were collected in plastic enclosures and may not be strictly comparable to the results expected in field use of this herbicide.

The area of greatest concern is with wildlife habitat and the effect 2,4-D has on it. From review of the research literature pertaining to wildlife, the greatest impact appears to be on sage grouse habitat, deer winter range, and antelope winter range. There are cases both on public and private land where use of herbicides has had detrimental effects on wildlife habitat. This has been true where large blocks - several hundred acres - of sagebrush have been sprayed and a high percentage of the sagebrush has been killed. On all spray projects, knowledge gained from research and experience is utilized in developing plans that will ensure the least possible adverse effect on the environment.

## I. CLIMATE

This program will have no effect on the overall climate. The microclimate will be altered to some extent, but the net result if not considered to be detrimental

## J. PLANNED MEASURES TO MINIMIZE ENVIRONMENTAL IMPACTS

1. Research and experience have shown that two pounds of 2,4-D (acid equivalent) per acre are necessary to consistently obtain a high percentage (90 percent) control of the target species (1, 14, 49, 61, 63). One and one-half pounds 2,4-D (acid equivalent) is being used for aerial application in an effort to control approximately 70 percent of the sagebrush. This has been determined to be a more optimum target level of control on the spray area.

2. The conventional method is to apply three gallons per acre of diesel oil as a carrier for 2,4-D. The combination of oil and herbicide tends to have a higher mortality effect than either one alone. Where this effect is termed to be undesirable, a water carrier can be substituted in some cases. Water as a carrier also has some undesirable characteristics. Water tends to evaporate, thus releasing some herbicide particles in the air allowing drift of herbicide to nearby areas. When evaporation, volatilization, and drift are deemed to be of an adverse nature, an inverting agent is used.

When the inverting agent "Bivert" is used, water is the major carrier component and diesel is reduced from three gallons per acre to less than one-half gallon per acre. The inert, inverting agent mixed with diesel oil (oil phase) forms a thick mayonnaise-like consistency which

encapsules the droplets of water and herbicide mixture (water phase) forming a droplet highly risistant to drift, evaporation, and volatilization. Droplet size of 400 to 800 microns is desirable.

3. The volatility of 2,4-D is largely dependent on the alcohol used to develop the esters of 2,4-D. Short carbon-chained alcohols develop high volatile esters, while long carbon-chained alcohols develop low volatile esters. Only esters of the low volatile nature are used.

4. Spraying is done by helicopter rather than by fixed-wing aircraft, since safe low-level flying at much reduced air speed can be accomplished with the helicopter. Also, the helicopter is maneuverable and allows precise herbicide application to the designated spray area. This reduces the chances of accidentally spraying nontarget areas.

5. Spraying is done when winds are less than six miles per hour, thus reducing drift to a minimum. Winds are monitored at all times on the project area during herbicide application.

6. Spraying is done when the temperature is below 70° Fahrenheit. This reduces problems encountered fro. evaporation, volatilization, and air turbulence. Temperature is monitored at all times on the project area during application.

7. All spray areas are carefully mapped using criteria developed in the planning process. The design of patches and strips is an important phase of the mapping. Spraying large blocks is avoided, since a "patchy" design is more compatible for use by wildlife - Figure 2.

8. Flags on tall poles or "flaggers" are used to further define "treat" and "no-treat" areas. Due to the scale of maps, all special areas cannot be shown on maps - Figure 2.

9. The size of spray areas is reduced by having untreated strips greater than 100 feet adjacent to streams, lakes, ponds, and sensitive nontarget vegetation types. On small acreages and confined areas application of herbicide is by a ground-based machine, where possible, rather than by helicopter.

10. All projects are supervised by personnel trained in application and handling of herbicides. Helicopter application is done by licensed applicators. Each helicopter is accompanied by a Forest Service employee COR (contracting officer's representative) who has had special safety training and has full authority to suspend operations if any hazard develops.

11. When possible, timing of application is done when target species are still susceptible and nontarget species are least susceptible to 2,4-D. This timing reduces the adverse effect on nontarget species, occurring on the spray area, which often have a different critical application time period.

Forbs are of most concern in planning an application timetable. This consideration is dependent on the species of forbs present. Generally speaking, spraying as early as snow and soil moisture conditions will allow access to the site, but after sagebrush starts to grow, is preferred. Most forbs are just starting to develop and are less susceptible to 2,4-D before flowering than during flowering time. This susceptibility appears to be related to photosynthesis and the translocation away from the roots to growing aerial portions of the plants. Thus, the tops are damaged but damage to the roots is reduced. Defoliation and injury to the cambium tissue of sagebrush species, other than A. cana and A. tripartita, is largely fatal to the plant and translocation to the roots is not so important.

## III. FAVORABLE ENVIRONMENTAL EFFECTS

### A. AIR

Herbicide itself is not known to have any favorable effects on air quality. When considering the use of herbicide as opposed to the alternatives of fire and mechanical methods, the air is kept free of smoke and dust.

### B. SOIL

The long-term favorable effects to the soil vary widely depending on the conditions that exist on each spray area. Benefits are most pronounced on areas where ground cover is sparse and where sagebrush makes up the major part of the vegetative composition. Benefit potentials are:

1. Increased ground cover to protect soil from high intensity rain, thus preventing movement of soil.

2. Increase in vegetation and litter cover on soil surface, thus aiding in absorption of precipitation.

3. Decrease in high fluctuation of soil surface temperature, thus providing better opportunity for seedlings to establish.

4. Improved soil structure due to increased amount and variety of roots, increased organic matter content, and increased activity of soil organisms.

5. Long-term improvement in fertility levels through better nutrient cycling provided by a stand of mixed vegetation rather than a few species.

6. Increased soil moisture level available to other plants (24).

7. Less interception of precipitation resulting in more precipitation finding its way to the soil to recharge the soil moisture supply (24).

### C. VEGETATION

The amount and type of favorable effects vary widely depending on conditions prior to treatment and capability of the site. Benefit potentials are:

1. Increased forage production.

2. Improvement in composition of desirable forage species, thus higher quality forage.

3. A composition diversity of plant species which provides:

a. Better buffer potential against insect and disease attack.

b. More diversified habitat for a greater number of animal and bird species.

D. WATER

Because most sagebrush areas fall in a low precipitation belt, these lands produce but little water for streamflow. However, if in poor condition, they lose considerable water from overland flow during high intensity storms. Such water lost is of poor quality when it reaches streams due to a high sediment load. Spraying sagebrush increases herbage production, which in turn improves ground cover, and root penetration and distribution. The overall effect is to reduce overland flow, but the water quality of any overland flow that does occur will be of higher quality due to a greatly reduced sediment load.

E. VISUAL APPEARANCES

The long-term effect of changing a given site from one dominated by dense sagebrush to a site expressing a variety of species is generally considered favorable. Initially, some of the desirable appearances are neutralized by the dead sagebrush stems.

F. SOUNDS, SMELL, AND HUMAN HEALTH

There are no known effects either favorable or unfavorable resulting from the program.

G. ANIMALS

The reduction of excessively dense sagebrush and the restoration to a more balanced vegetative cover induced by the treatment, results in increased carrying capacity of the land for livestock and often enhances the overall wildlife habitat. Increases in capacity must be measured by weighing the losses against the gains. Excessive reduction of sagebrush may be detrimental to some animals and favorable to others. Each project must be designed so that the amount of area treated and degree of sagebrush controlled brings about an optimum balance. One must be able to separate actual gains and losses from the theoretical gains and losses. Following are known favorable effects that occur:

1. Livestock. Increased forage production can be expected. Sustained increases of 800 pounds to 1,500 pounds of airdry forage per acre are common (1, 16, 31, 49, 61). Without reduction of dense sagebrush, only slight improvement in forage yield can be expected on many ranges even after good grazing practices have been used for 15 to 30 years (49, 58). Improved livestock management is much more practical when higher yields are obtained. Frequently livestock losses from poisonous plants are reduced.

2. Elk. Elk can benefit along similar lines as livestock. Response may not be as great because of the difficulty in management of the animal itself.

On two study sites on the Gros Ventre River drainage in Wyoming it was found that elk showed a 55 percent increase in use on one treated site and 89 percent increase in use on the other site one year, and a 40 percent increase in use on both sites the previous year, as compared to adjoining untreated big sagebrush sites (65).

3. Antelope. Benefits to antelope appear to be dependent on removing only the big sagebrush that is excess to their needs. With this criteria in mind, they will benefit by increased forage supply and variety (6). Observations by Forest Service Officers indicate that antelope tend to avoid tall dense sagebrush if they have a choice. It has been suggested that antelope prefer range where they have freedom to run and are able to observe predators.

There are instances where antelope have extended their use of range in areas where density of sagebrush has been reduced by use of 2,4-D. An example of this is the Mosquito Lake area in western Wyoming. Sundstrom, 1966, briefly researched history of antelope in this area and stated:

> Historical data indicates that in the year 1925, the last antelope were observed inside the Bridger National Forest in the Mosquito Lake area. Only two antelope were observed at that time. Indications are that antelope apparently did not inhabit this area again until the middle 1950's. In 1963, five Forest Service personnel counted 196 antelope within the vicinity of Mosquito Lake. (72).

Nearly 9,000 acres of sagebrush were sprayed in the Mosquito Lake area from 1956 to 1959. Mortality on mountain big sagebrush was considered high, and about 50 percent on silver sagebrush. Canopy density on mountain sagebrush presently falls in the 10 to 30 percent range. Utilization observations show that utilization on sagebrush species is light. When large acreages of sagebrush are available to provide a choice, antelope favor sagebrush with a canopy density of about 10 to 30 percent (6, 18).

4. Mule Deer. Deer are similar to antelope except they will utilize tall brush more readily. The value of sagebrush, particularly those species or subspecies high in volatile oils, can be overrated for big game. Analysis of reports on feeding trials, laboratory tests, and rumen sample examinations indicates that an optimum level of sagebrush in a deer's diet would fall somewhere around 45 percent, providing a mixture of other nutritious forage is available (13, 18, 26, 43, 55). Where bitterbrush and other root sprouting shrubs occur, reduction of sagebrush greatly increases the potential for increased production of other shrubs

which can contribute substantially to a more balanced diet. After wintering on course shrubs, wildlife relish the lush vegetation found when a sagebrush-grass type has a good balance of palatable grass and forbs in the composition.

5. Rodents. There does not appear to be any effect on mice, but similar rodents tend to decrease. Studies by Johnson and Hansen in Colorado on sagebrush-grass range and grass-forb range showed the density and litter size of deer mice were little affected by the use of 2,4-D at two and three lbs. per acre acid equivalent. The density of pocket gophers and least chipmunks was reduced while the montane vole increased. With reestablishment of forbs on the treated sites, the pocket gopher and montane vole populations returned to pretreatment levels (28). Turner, reporting on a 19-year study in Colorado, concluded that ranges could be improved either by poisoning and trapping gophers or by using 2,4-D (58).

6. Sage Grouse. As stated earlier, sage grouse desire certain densities and size classes of sagebrush in their seasonal habitats. When sagebrush increases beyond this point the quality of their habitat is reduced. Following treatment, excess sagebrush is replaced by other desirable plant species, some of which are vital to the welfare of the young chicks.

## IV. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

### A. AIR

Because of volatilization and evaporation, a small amount of herbicide may remain suspended in the air for a short period of time following application. Since 2,4-D is rapidly broken down by organisms and photodecomposition, this impact is small and short lived.

### B. SOIL

Some of the applied 2,4-D will eventually reach the soil. However, at the concentration used, 2 pounds or less acid equivalent per acre, any impact on the soil will be temporary. The 2,4-D is readily broken down by plant metabolism, soil micro-organisms, hydrolysis, photodecomposition, and chemical decomposition (23, 36). The loss of sagebrush might result in a temporary increase in soil displacement due to raindrop splashing action on bare soil, but the rapid increase of other vegetation coupled with interception by dead sagebrush plants more than offsets this hazard. See discussion under Part II, B.

### C. VEGETATION

Policy of the Forest Service Intermountain Region is to make a qualitative and quantitative evaluation of each project area before treatment and to follow up with further evaluations two years and five years after treatment. Continued analysis of this data gives a reliable index as to vegetative response. These measurements show that some desirable plants are killed. However, there is no evidence that any one plant species, even those plants highly susceptible to 2,4-D, has been permanently eliminated. The greatest impact occurs immediately after treatment, but plant species tend to regain their ecological status in a few years.

### D. WATER

The maximum amount of 2,4-D expected to enter water is .01 ppm when two pounds acid equivalent per acre is applied in the conventional diesel carrier (46). Use of lighter concentrations should reduce this amount proportionately. Intermountain Region hydrologists are of the opinion that there will be no detrimental effect on water production. See section II,D, for further discussion in water contamination.

### E. SOUNDS, SMELL, ESTHETICS, AND HUMAN HEALTH

The sounds of the helicopter and pumps are short lived and will be gone as soon as the project is completed. The smell of 2,4-D is short lived and disappears within a few days depending on temperature and weather conditions. The appearance of sagebrush is not suddenly changed after spraying. By fall of the first year defoliation is apparent. Most

change takes place during the first winter, and by the following spring the treated area is dominated by dead sagebrush stalks. This appearance is gradually changed as snow and animals break down the dead stalks and other vegetation dominates the scene.

There is little if any hazard to human health if the chemicals are used as prescribed (22). The hazard is primarily accidental exposure of 2,4-D concentrate to the skin or eyes of workers handling the chemical. When "flaggers" are used, they are located at each end of the flight strip. The flagger stands long enough for the pilot to line up with him and then quickly moves out of the way. There is some contact with the spray mixture in some instances. This chemical is readily degraded and does not pass up the food chain (22).

## F. ANIMALS AND BIRDS

The only known potential hazard to birds and animals is the possible damage to habitat. The planning process is geared to recognizing all potentially adverse impacts and then modifying the program to eliminate the serious ones. The possibility exists that some impacts may not be recognized. At the present time there are no known rare or endangered species that will be adversely affected by the proposed spray program. See section II, H for more complete discussion of potential impacts. Section I, F described ecological systems involved and criteria used in attempts to reduce impacts to a minimum.

## V. ALTERNATIVES TO THE PROPOSED ACTION

This environmental statement has been prepared to describe the use and potential impacts of 2,4-D on a portion of the sagebrush-grass and wyethia-grass types. With many years of experience in management techniques, stocking levels, mechanical treatments, and approximately 20 years experience in application of herbicides, we believe that the use of the plant growth regulator 2,4-D is a highly viable alternative to use on selected acres which amounts to approximately 17 percent of the total area dominated by sagebrush and wyethia. Other cultural treatments such as burning and chaining would have limited potential on these selected areas because of special conditions that must be present before they are effective. These conditions will be explained under the proper alternative heading.

### A. PRESCRIBED BURNING

Prescribed burning as used here is defined as the application of fire to sagebrush stands under predescribed conditions of weather, fuel moisture, soil moisture, wind intensity and direction, and numerous other factors that will allow confinement of the fire to a predetermined area, and at the same time accomplish the objective of sagebrush removal with minimum damage and acceptable cost. There are two periods during the year when burning can be effectively done--early spring and midsummer.

Early spring burning must be accomplished shortly after snow has left and before any plant greenup occurs. Soil moisture and ground fuel moisture must be high to avoid destruction of nontarget vegetation. High winds in the proper direction and sufficient dry fuel to carry the fire must be present. Natural barriers or firelines must be so situated as to confine the fire to the target area. The size and configuration of the burn area must be such that impacts above the tolerable level would not occur. Three prominent potential impacts are destruction of other improvements, injury to intermingled desirable shrubs or trees, and displacement of critical habitat. All of the required conditions seldom occur at the same time.

Midsummer burns are highly hazardous and require considerable precautionary preparation to confine the fire to target areas. Prescribed conditions peculiar to each site must be present. Potential impacts are essentially the same as for spring burning, but their occurrence is likely to be more severe.

Free-burning fires (wildfire) has always been a part of the ecology. Ecologists consider wildfire to be a significant factor in creating the habitat within which native wildlife evolved. Civilization has been a major influence on reducing the effect of fire. Highways, green belts, heavy grazing, and effective fire prevention and control measures have all altered the fire ecology.

Prescribed burning is an effective but seldom used tool for vegetative manipulation. When the necessary conditions exist and burning appears to best meet the management objectives of a specific area, it becomes a highly viable alternative.

ALTERNATIVE A - PRESCRIBED BURNING

| | Environmental Effects | | |
|---|---|---|---|
| | Favorable | Adverse | Other Factors |
| Air | | Smoke output adds to visual pollution. | Burning has high level of limitations and can only be used effectively when conditions are favorable. |
| Soil | Causes faster recycling of nutrients formerly tied up in sagebrush plants. | Increases soil exposure to wind and water erosion temporarily. Hot fires destroy favorable litter accumulation for two to five years and may cause crusting to surface (12). | Firelines may be a severe impact on soil. Rehabilitation is needed after burning. |
| Vegetation | Forbs tend to recover faster (12, 41). Nutrients are released for use by plants.<br><br>Removes decadent overstory and promotes root sprouting of some shrubs. | Nonselective. Top-kills plants that are resistant to 2,4-D. May kill bitterbrush (41).. Hot fires completely kill many plants. Risk of burning nontarget areas. May make area vulnerable to heavy big game use, thus adding impact to sprouting shrubs. Temporarily destroys habitat for most forms of wildlife. Usually complete loss of sagebrush. | Usually requires nongrazing year preceding burn so that dry vegetation can carry fire. Requires nongrazing use the year following fire to assure recovery of desirable plants. After recovery period burned areas compare favorably with other treatment methods. |
| Water | | Possibility of increased eorsion adding silt to streams. Large accumulations of ash create lye in water. | |

ALTERNATIVE A - PRESCRIBED BURNING (Cont.)

| | Environmental Effects | | |
|---|---|---|---|
| | Favorable | Adverse | Other Factors |
| Visual | Few dead sagebrush plants to be seen. May increase number of flowering plants. | Burned area is not esthetic. There may be smoke pollution. Burned areas are more obvious from greater distance. | Burned area may remain green for longer period of time year following fire. |
| Sounds Smell | | Smoke travels off site. | Control noise is probably higher than herbicide application. Very difficult to schedule. |
| Human Health & Economics | | Inhalation of smoke and irritation of eyes. Risk of escape, thus burning improvements. Accidents. | |
| Animals & Birds | Forbs recover faster. | Loss of food and cover first year. Small forms of wildlife may be burned. Not compatible with sage grouse nesting areas. Removes habitat for certain birds and small forms of animals. | New growth attracts some species of wildlife. |
| Microclimate | | Temporary change of microclimate - greater than 2,4-D. | |

Prescribed burning can be a useful tool and is employed when benefits are determined to offset losses. Prescribed burning, like other alternatives, has a place when conditions are favorable.

B. CHAINING OR RAILING

Chaining and railing have been employed extensively. Chaining has, with few exceptions, replaced railing. Chaining is done by connecting approximately 300 to 400 feet of anchor chain to two large crawler tractors. With a tractor connected to each end of the chain, the chain is pulled in a "U" or "J" shape. Generally sections of railroad rail are welded to each link creating rough surfaces for scarification. Severity of the scarification treatment is usually regulated by chain weight, repeated treatment, distance between tractors in relation to chain length, or a combination of these.

Only a small percentage of the area proposed for herbicidal treatment would qualify for chaining. For chaining to be effective on sagebrush removal, the plants must be brittle so that the plant can be broken off or pulled up. The majority of the area proposed for herbicidal treatment contains mostly sagebrush plants that are too flexible to be effectively removed by a chain without destruction of many other desirable plants (to be effective the area would have to be chained over several times at increased cost).

The cost figures shown in section I, G, 5, b are for large projects where the cost of moving chains and tractors can be amortized over a large acreage of approximately 1000 acres or more. Chaining small projects would raise the cost considerably. The majority of the herbicide projects contain less than 500 acres and are dispersed over a large area.

When it is desirable to plant other species after partial removal of sagebrush, chaining provides an excellent seedbed and is generally used providing the sagebrush competition can be reduced sufficiently for seedlings to establish.

ALTERNATIVE B - CHAINING OR RAILING

| | Environmental Effects | | |
|---|---|---|---|
| | Favorable | Adverse | Other Factors |
| Air | | Often creates dustclouds. | |
| Soil | Breaks down shrubs placing more litter on the soil surface. | May turn up boulders that are normally partly buried. May subject soil to erosive action by wind for short period of time. | Use is limited to relatively flat terrain with little or no rock. |
| Vegetation | Severity of kill of desirable plants can be regulated. May rejuvenate decadent desirable shrubs. | May activate dormant seeds of unwanted plants. May break down desirable shrubs, thus requiring root sprouting. Shrubs must be mature and woody before chains can do effective control job. This limits use on many sites. | Little or no change in fire hazard. |
| Water | | | Sediment production generally insignificant. |
| Visual | Less noticeable dead brush after recovery. | | Area looks badly torn up for about one year. |

ALTERNATIVE B - CHAINING OR RAILING (Cont.)

| | Environmental Effects | | |
|---|---|---|---|
| | Favorable | Adverse | Other Factors |
| Sounds Smell | | Noise period much longer. | |
| Human Health and Economics | Less chance of chemical injury. | More expensive to use. Difficult and expensive to transport equipment. Limited supply of equipment. More chance for physical injury due to lifting. | Nature of accidents may change. Anchor chains are very expensive to build and maintain. |
| Animals & Birds | | May injure or kill small animals. Requires use during non-nesting period. | 2,4-D is not considered to be injurious to animals in concentrations used. |
| Micro-climate | | | Probably similar to use of 2,4-D. |
| Cultural | | Requires special planning and treatment of area when archeological materials and sites are in the treatment area. | |

C. PLOWING

Plowing is seldom an alternative to spraying sagebrush because plowing requires reseeding while spraying is employed when total plant removal is not desired and reseeding is generally not needed. Plowing is usually employed when plant composition is such that other treatment methods are not adequate to meet land management objectives. Watershed restoration is frequently a major objective when plowing is employed.

ALTERNATIVE C - PLOWING

| | Environmental Effects | | |
|---|---|---|---|
| | Favorable | Adverse | Other Factors |
| Air | | Often dusty. | |
| Soil | Breaks up hard surface crust. Tends to break up gully patterns. | High erosion hazard compared to other methods. Limited to smooth, boulder-free terrain. | |

ALTERNATIVE C - PLOWING (Cont.)

| Environmental Effects | | | |
|---|---|---|---|
| | Favorable | Adverse | Other Factors |
| Vegetation | Better control of undesirable plants that are resistant to 2,4-D. Provides seedbed when seeding is needed. | Kills nearly all vegetation. Requires seeding in all cases. Cannot establish diversity of species that are in the natural plant community. | |
| Water | | May temporarily create high level of siltation. | |
| Visual | Less dead brush showing. | Soil almost completely bare about one growing season. | |
| Cultural | | Requires special planning and treatment of area when archeological material and sites are in the treatment area. | |
| Sound Smell | | Sound period much longer. | |
| Human Health & Economics | | Most expensive to use. Equipment is expensive and has high maintenance level. Requires high-powered tractor. Near complete loss of wildlife habitat during recovery period. | |
| Microclimate | | Complete change in microclimate. | |

D. USE OF A DIFFERENT HERBICIDE

There are many herbicides that will do the control job desired; however, 2,4-D has proven to be the most economical. Most other herbicides have a longer residual life and tend to be less selective for use on target species. Use of other known and tested chemicals for the intended purpose is not considered to be a viable alternative. Development of new herbicides may some day replace 2,4-D for this use.

E. USE OF A DIFFERENT FORMULATION OF 2,4-D

See discussion under II. - Planned Measures to Minimize Environmental Impact. The Intermountain Region has used many formulations of 2,4-D. Two basic low volatile forms are esters and amine salts. Esters and amine salts respond differently.

Amine Forms

1. Tend to have longer residual life (39).

2. Tend to have erratic effect on target species.

3. Tend to require more pounds per acre to obtain similar results of ester forms.

4. Tend to be noncompatible with invert emulsions when used in small quantities per acre.

5. Tend to be more stable than esters.

Ester Forms

1. Tend to be more volatile than amine forms.

2. Tend to give more uniform control.

3. More compatible with invert emulsions.

F. BIOLOGICAL CONTROL

There are no known practical methods of biological control specific to target species even though some insects such as Aroga websterii present some possibility.

G. INTENSIVE RANGE MANAGEMENT WITHOUT SAGEBRUSH TREATMENT

This alternative is employed to the extent possible regardless of other treatments applied. Intensive livestock management, with or without cultural or chemical treatment, will be the prevalent practice employed to maintain the range environment in a desirable condition or to rehabilitate deteriorated ranges. Grazing sagebrush range with sheep during fall and winter season has been used successfully to reduce sagebrush density, but has limited possibilities. Chemical and mechanical treatments are used to assist recovery of ranges that are in unsatisfactory condition and in maintaining some vegetative types in a seral stage to provide greater returns to society.

It is estimated that approximately 60 percent of the sagebrush type occurring in the Intermountain Region would benefit from herbicide or mechanical treatment. The FRES data bank shows 213,000 acres (57%) of the sagebrush land in Wyoming on Intermountain Region National Forest land as being in the lowest of three condition classes. Forest officers have estimated that only 18 percent would qualify for herbicide treatment after being subjected to the environmental planning process. At the present rate of herbicidal treatment it will take more than 30 years to treat the 18 percent for the first time. In addition, it is estimated that herbicide control will be effective for an average of 20 years or more. Any retreatment will prolong the program.

H. TAKE NO ACTION

This is not a viable alternative, when deteriorated conditions exist and practices that are environmentally sound can be employed to hasten recovery. The Forest Service is charged by law to manage National Forests and National Grasslands on a sustained yield basis. When deteriorated conditions exist, they must be corrected. In this case the alternative of taking no action does not meet the objective of sustained yield management, when benefits outweigh the impacts.

This alternative would have the advantage of not causing impacts created by other alternatives. It would also preclude realization of the benefits derived from range land improvement by other alternatives.

In a number of instances this alternative would require considerable reduction in livestock production, thus a considerable loss to the local economy. Where rehabilitation is needed to curb accelerated erosion, the erosion would continue until the slow processes of nature could be effective.

## VI. RELATIONSHIP BETWEEN SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE OF LONG TERM PRODUCTIVITY.

Vegetative modification is an integral part of an overall long-term productivity program. On grazing allotments, intensive grazing management systems are being employed. These systems are designed to improve or maintain vegetative composition, forage quality and quantity, improve or protect the soil and its hydrologic function, and enhance, where possible, values for other uses. On poor condition ranges intensive management helps improve conditions, but when high densities of less palatable and highly competitive species occur, such as sagebrush and wyethia, improvement by intensive management alone is slow and may preclude the realization of the management objectives for the overall program.

The long term productivity of areas treated with 2,4-D is improved by developing a plant community capable of holding the soil in place. Once soil is lost from a site, productivity goes down. Development of additional soil from parent material is a very slow process.

As stated elsewhere in this statement, a balanced composition of many plant species has more ability to withstand catastrophic occurrences than a simple plant composition. For example:

1. Insects and disease generally affect only a few plant species at any one time. A complex plant composition provides a variety of habitat conditions for natural predators to control insect buildup. If one plant species is affected by disease, other species are there ready to occupy the site left by the plant killed from disease, thus keeping bare soil areas to a minimum.

2. A productive variety of plant species form many kinds and variations of habitat for wildlife and domestic livestock. These habitat differences better provide for a larger variety of uses without the uses being in serious conflict with each other.

3. Wyethia has a short growth period. It generally matures early in the summer and then dries up. When a dense stand of this plant has matured and dried, considerable soil is left exposed to high intensity storms that are common during July and August.

## VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

This program will cause no known irreversible or irretrievable commitment of resources.

## VIII. CONSULTATION WITH OTHERS

### A. ANALYSIS OF COMMENTS RECEIVED ON THE DRAFT STATEMENT

1. General. Fifty-six copies of the draft statement were mailed out for comment. In addition, a notice of the availability of the statement was sent to eight newspapers with distribution in Wyoming. Nine responsed were received with comments regarding the draft statement.

Where additional information was furnished or clarification was indicated, the statement has been revised to include these items.

The draft statement was based on the premise that the cumulative effect of treating 18 percent of the sagebrush acreage with 2,4-D over a 30-year period and the controversial use of 2,4-D should be evaluated in an environmental statement. All of the predicted environmental impacts and effects described in the draft and final statements are based on the firm premise that needed protective measures will be taken in planning each project, applying the treatment, and in followup management. Also, an environmental analysis will be prepared for each project prior to approval, to fully evaluate the impacts involved. We do not agree with the premise advocated by some that environmental statements must be filed on a project-by-project basis.

2. Federal Agencies

United States Environmental Protection Agency by John A. Green, Regional Administrator, Denver, Colorado. This agency had no objections to the draft statement and stated that it was adequate. It suggested that section II, J, 11 be emphasized. An attempt has been made to clarify this part in the final statement.

United States Department of the Interior, Washington, D. C. No response was received from the USDI.

Soil Conservation Service, USDA, by Blaine O. Holliday, State Conservationist. Comments on the draft statement were favorable. The editorial comment suggesting "livestock" be added behind "big game" in the eighth sentence of section II, C, 4 was considered. The statement points out that permitted livestock are to be managed under a system of management with prescribed rest periods in a manner that will maintain the vegetation. After treatment there is no reason to infer that livestock would be allowed to graze bitterbrush excessively. The biggest potential hazard to bitterbrush lies with the difficulty of managing big game animals.

We question that rephrasing or reorganization of the statement would help significantly. When people of varied interests, professions, and levels of understanding are to read the same technical document, there

will be considerable misinterpretation of its content regardless of its organization. We are not at liberty to make significant changes in the outline because it is prescribed by Service-wide direction.

Wyoming Game and Fish Department by James B. White, Commissioner. The comments received were largely in opposition to the proposal. The allegation is that the statement is inaccurate, nonfactual, inadequate, inconclusive, and lacked thoroughness.

The Department takes issue with the conclusions drawn regarding the volatile oil problem of sagebrush in the diet of mule deer. The discussion on mule deer in section I, D, 2, b, (2) and III, G, 4 are valid. These sections have been revised because of questions raised. It is true that results from any study have to be judged on their merits and are only an indication of what might be expected in other circumstances. After review of considerable literature on the subject in addition to our own observations and studies, we believe the approximate limit of 45 percent sagebrush in the diet of deer is realistic. This would vary depending on the oil content of the various stands of sagebrush. Nagy et. al. pointed out that their tests were only with deer rumen bacteria cultures and with a fistulated steer; they also stated, "According to these results, cellulose digestion will be slowed down slightly if the diet contains 15-30 percent (depending on oil content) sagebrush." They further stated that completion of digestion was retarded one day in the culture tests. See page 790 of their report. Additional information on this subject can be found in Applied Microbiology, January 1968, Volume 16, Number 1, pages 39-44, by Hi Kon Oh, M. B. Jones, and W. M. Longhurst.

It is certainly true that we cannot expect response from other shrubs in a sagebrush stand if they don't exist or are not adapted to the specific site. On many mountain ranges the other shrubs do exist and are adapted to various degrees.

The authors are aware of many studies involving elk. The section on elk has been supplemented with additional data collected on National Forest ranges that are included in the proposal. The Intermountain Forest and Range Experiment Station, with headquarters in Ogden, Utah, has research responsibility over that part of Wyoming covered by the environmental statement. Copies of the draft statement were sent to their Ogden office. This is the reason why copies were not sent to the Rocky Mountain Forest and Range Experiment Station. It was our opinion that adequate technical input would be supplied by the Bureau of Sport Fisheries and Wildlife and the Wyoming Game and Fish Department.

Known elk calving areas need special consideration in planning vegetation manipulation projects and assistance from the Wyoming Game and Fish Department personnel can be of considerable help.

We agree that spraying sagebrush may not be of benefit to deer, antelope, and sage grouse in all cases. The important consideration is to identify those cases where the practice will truly be detrimental and resolve those conflicts before proceeding with the specific project.

The section on rodents has been supplemented with additional data.

The sections on birds and mammals have been supplemented with additional data. We did not find any literature showing impacts on unmentioned species. A few other individuals have posed the same question but none provided any factual information.

We agree that the Western States Sage Grouse Committee Guidelines are an excellent source of information. This document was used extensively as a guide to develop Forest Service manual direction for vegetation type manipulation in this Region.

Discussion on blue and ruffed grouse is included in the final statement.

The discussions on antelope in sections I, D, 2, b (1) and III, G, 3, have been revised and supplemented. The referred to "Charles Sundstrom Report" has been cited in the final statement.

The Department suggested that an allowance be made in the economic analysis for loss of wildlife forage. We agree, if an actual loss should occur. To do this the losses and benefits must be converted to dollar values. We fully agree that sagebrush is important to antelope. However, grazing values of sagebrush in the Red Desert area of Wyoming are not necessarily indicative of values on mountain summer range. The proposal as described does not consider spraying sagebrush on land other than National Forest land. The Red Desert area of Wyoming is far removed from proposed target spray areas.

There does not appear to be significant or measurable impacts on microorganisms and insects. Some comment on insects was made in the draft statement and additional data is included in the final statement. Indications are that soil microorganisms can use 2,4-D as a source of energy.

Additional data on impact of aquatics has been added to the final statement.

We agree that areas lying in or near prime moose habitat, particularly critical range, should have special consideration because of the potential impact to other species of plants. To say that it should not be treated at all is a rather broad statement. Benefits could more than offset detrimental impacts, and we should not rule out this potential.

We believe that adequate emphasis is contained in the statement to show that each individual project is separately analyzed. See section I, E.

There was no intent to exclude distribution of the draft statement to anyone. We sent extra copies to the University of Wyoming for distribution.

Special consideration must be given to the needs of bighorn sheep wherever they occur. Artemisia frigida, a half shrub, and many herbacious species of Artemisia are used by some wildlife species. These are not target species, but may occur in some target areas. Their importance has to be considered on each project area.

The stated purpose of the proposal in section I, B, is correct.

In order to obtain discount figures from interest tables, twenty years were used in the economic analysis. There has been no intent to imply that a climax condition is involved. Additional data has been included in the final statement so that the reader can better evaluate the natural position of target species of sagebrush. The discussion of the various species of sagebrush points out some of the management problems involved.

We believe the alternatives offered are adequately accounted for. Intensive range management must be practiced, with or without other treatments, if we are to avoid a repeat of the grazing problems that occurred in the late 1800's and early 1900's.

It was stated, "Most states in the Intermountain Region have reported a general overall increase in sage grouse since 1965." The reference cited was Minutes of the Seventh Biennial Western States Sage Grouse Workshop, June 1971, by Darrell H. Nish. There was no reference to a Nevada study in this document.

The concept of improving meadows for sage grouse by Savage (a Nevada study) applies in various degrees to all western states. The 1968 guidelines, prepared by Western States Sage Grouse Committee, stated "In some areas brush has encroached upon meadow lands primarily due to a lowering of the water table. It is recommended that in some such situations big sagebrush and rabbitbrush (Chrysothanmus spp.) be removed along streams and desiccated upland meadows to the extent of original meadow boundaries." The Western Association of State Game and Fish Commissioners resolved to ". . . call attention to, and support the use of, these Guidelines for Habitat Modification in Sage Grouse Range." We have relied heavily on these recommendations in designing our herbicide projects.

The statement regarding intensive management in section I, K, states, in part, "This management system does not require permittees to reduce permitted livestock use as a result of the spray project." This means that additional nonuse is not required as a result of spraying. "Regardless of whether an area receives chemical or mechanical treatment or not, grazing must be kept in balance with forage supply and be compatible with other values as directed by the Multiple Use and Sustained Yield Act." This means that all grazing, by domestic livestock and wildlife, must be managed to be compatible with other National Forest uses. Adjustments either upward or downward may be desirable depending on each individual case.

The Department stated: Reduction of some forbs is not beneficial to deer or antelope. It may not be detrimental to them either. This depends on the circumstances involved.

Additional data has been included in the final statement in regards to aquatics.

The Department states they do not feel 100 foot buffer strips along streams to be sufficient. According to the Department's comments on page three, third paragraph, this is the Sage Grouse Committee's Guidelines. In many cases 100 feet or even 100 yards are not sufficient to provide needed protection. The 100 foot limitation is set to be a minimum; it may and should be widened to the extent necessary according to the specific situation.

The purpose of environmental statements is not to justify projects. There are numerous other laws, regulations, and policies that provide for this. All people do not agree that all projects should be done. The general tendency is that people tend to favor their special interests and reject the overall "Multiple Use" approach. If a justification statement was intended, this environmental statement would have been addressed to that point.

University of Wyoming - Plant Science Division - College of Agriculture and Experiment Station, by Dr. Harold P. Alley. Dr. Alley was complimentary on the statement and made many interesting comments.

Dr. Alley stated that the statement could have pointed out that only six percent of the adaptable acreage of sagebrush in Wyoming has had control measures applied. We tried to focus the reader's attention to the proposal on Intermountain Region National Forests and not get involved in the vast acreage of sagebrush found elsewhere.

Use of different chemicals and formulations as used in the statement are described in section V, D & E. We agree that 2,4-D is the most logical chemical to use. Nevertheless, use of other chemicals is an alternative to 2,4-D. The stated objective was to obtain approximately 70 percent control of sagebrush on areas treated. We pointed out that higher concentrations of amine 2,4-D would be necessary to obtain the same degree of control as with ester forms.

Comments related to sagebrush in deer diets were added to the final statement.

Dr. Alley was somewhat critical of the project costs of $5.82 per acre as compared to private land costs of near $3.50 per acre. We, too, are concerned about the high costs. We believe that if the private landowner figured in all his costs as we did, his cost would be higher. Our contract prices always run high, apparently because of the strict safety requirements placed on the contractor. Our contracts also include disposal of all containers in an approved manner as prescribed by law. We have strict limitations on the hours a pilot can fly during the week, which sometimes requires relief pilots to be available.

Normally, we do not require deferring use of treated areas other than the year of treatment. There may be exceptions, however, due to other needs or if additional deferrment is determined to be desirable.

It is true that most amine formulations of 2,4-D are not compatible with diesel oil. However, amine could be used with a water carrier.

We agree that an average of 2,000 acres per year is a small amount and that the total value of the program may never be realized. However, if this average can be maintained, we believe we can take care of the most pressing problems.

We are interested in the publication, "The Use and Effects of Pesticides For Rangeland Sagebrush Control", and will attempt to obtain one or more copies.

University of Wyoming - Plant Science Division - College of Agriculture and Experiment Station, by Dr. Alan Beetle. Dr. Beetle was complimentary on the draft statement and stated, "I found it to be an up to the minute and sophisticated report. I can find nothing in it to criticize."

University of Wyoming - Agricultural Extension Service, by Thomas E. Bedell, Extension Range Specialist. Mr. Bedell was complimentary on the draft statement and offered editorial comments.

Mr. Bedell suggested that we drop the word "control" and use terms such as management, manipulation, or modification. The point is well taken; however, control means: to exercise restraint or direction over, to hold in check, to regulate, etc. Our objective is to control density of target species by management and manipulation.

As suggested by Mr. Bedell, the term "density" was used incorrectly in one place in section I, D, 1, a, (2), (b). It should have been "crown density" or a similar term. This is changed in the final statement.

We agree that plowing and seeding would frequently provide forage increases above .4 AUM,s per acre. However, the one project cited was on a low productive site on shale soils derived from the Greenriver Formation. Normally, we do not have to plow except under extreme conditions often where watershed restoration is involved.

We, too, hope that the statement will be adopted; however, the final statement has been added to extensively in clarification and data.

Wyoming Wildlife Federation, by John C. Borzea, Director, Rock Springs, Wyoming. Mr. Borzea was complimentary on the draft statement.

It is the Forest Service's desire that State Wildlife Biologists participate in planning vegetative modification projects.

Mr. Borzea expressed concern about the 100 foot minimum unsprayed strip required around water. This is the minimum; however, it can and shall be extended to the distance necessary. Areas known to be critical to the welfare of wildlife, winter or otherwise, shall not be programmed for herbicide treatment unless the application is known to not be detrimental to the wildlife involved.

The predicted average of 2,000 acres per year is an average. On any one year this acreage might be exceeded. It should be understood that this would be in patches and not in large blocks.

The Forest Service does not have any plans to use fixed-wing aircraft for treating sagebrush or wyethia.

Other comments by Mr. Borzea are contained in the text of the statement.

Wyoming Outdoor Coordinating Council, by Meridan H. Bennett. Mr. Bennett was complimentary on the draft statement and suggested three items of comment be considered in preparation of the final statement.

a. Concern was expressed that adequate personnel to act as flaggers, project supervisors, or other necessary personnel may not be available to provide adequate control. Our goal is that quality of work must take precedence over quantity of work. If adequate personnel are not available to do a job, the job should be delayed or modified until it can be provided with adequate personnel.

b. Additional data has been added to the statement, particularly in relation to toxicity and aquatics. It is not clear just what the concern for the legumes is. Three groups of legumes are primarily involved. These are the lupines, vetches, and locoweeds. The symbiotic nitrogen fixing ability of some legumes, the value they may have as forage, and their poisonous properties all have to be considered on each project to determine the method of treatment and, in fact, if any treatment should be done.

c. Concern was expressed for possible mutagenicity of birds and animals. All the research we have been able to find in relation to toxicity, teratogens, mutagens, and carcinagens is related to the concentration of 2,4-D. Considerable data has been added to the final statement to show the hazards related to concentrations of 2,4-D that are involved. We agree with the conclusions of House et. al. as stated in section II, H of the statement. We have thoroughly reviewed the environmental statement prepared by the northern Region, U.S. Forest Service, and several others. Mr. Bennett is correct - these comments are not new to us; however, we appreciate the fact that our draft statement was thoroughly studied and comments received.

The Izaak Walton League of America, by Burton W. Marston, Chairman, Public Lands Committee, Laramie, Wyoming. Mr. Marston was complimentary on the draft statement and expressed considerable concern and philosophy regarding this proposal. We agree with his comments.

He expressed concern that only 2,000 acres would be treated each year. The 2,000 acres applies only to National Forest land in the Intermountain Region and is quite minor in relation to the total need for Wyoming.

B. AGENCIES, GROUPS, AND INDIVIDUALS TO WHOM THE FINAL STATEMENT WILL BE SENT

Mr. William M. Hoffman — 3 copies
Office of Pesticides Programs
Environmental Protection Agency
Washington, D. C. 20460

Mr. John A. Green
Regional Administrator
Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Mr. Bruce Blanchard, Director — 18 copies
Office of Environmental Project Review
U.S. Department of the Interior
Main Interior Building, Room 5313
19th and C Streets N.W.
Washington, D. C. 20240

Department of Health, Education, and Welfare
330 Independence Avenue S.W.
Washington, D. C. 20201

Dr. Robert Harris, Director — 4 copies
Intermountain Forest and Range Experiment Station
Forest Service Building, 25th and Adams
Ogden, Utah 84401

Mr. Daniel P. Baker, Wyoming State Director — 10 copies
Bureau of Land Management, U.S. Dept. of the Interior
U.S. Post Office and Court House
2120 Capitol Avenue
P.O. Box 1828
Cheyenne, Wyoming 82001

Mr. Blaine O. Holliday, State Conservationist
Soil Conservation Service, USDA
P.O. Box 2440
Casper, Wyoming 82601

Dr. A. C. Hull, Range Scientist
Agricultural Research Service, USDA
U.M.C. 63 Crops Research Laboratory
Utah State University
Logan, Utah 84322

Dr. E. H. Cronin, Plant Physiologist
Agricultural Research Service, USDA
U.M.C. 63
Utah State University
Logan, Utah 84322

State Planning Coordinator
Office of the Governor
Capitol Building
Cheyenne, Wyoming 82001

Mr. James B. White, Director — 5 copies
Wyoming Game and Fish Commission
P.O. Box 1589
Cheyenne, Wyoming 82001

Dr. Lloyd C. Ayres, Asst. Dean and Director — 3 copies
College of Agriculture
University of Wyoming
University Station, Box 3354
Laramie, Wyoming 82070

Dr. Harold P. Alley, Professor of Weed Science
Plant Science Division, College of Agriculture
University of Wyoming
University Station, P.O. Box 3354
Laramie, Wyoming 82070

Dr. Alan A. Beetle
Plant Science Division, College of Agriculture
University of Wyoming
University Station, P.O. Box 3354
Laramie, Wyoming 82070

Mr. Thomas Bedell, Range Management Specialist
State Extension Service
Box 3354, University Station
Laramie, Wyoming 82070

Mr. John C. Borzea, Director
Wyoming Wildlife Federation
1306 Kimberly Avenue
Rock Springs, Wyoming 82901

Mr. Edwin J. Merrick
Field Representative
National Wildlife Federation
710 South 41st Street
Boulder, Colorado 80302

Mr. Burton W. Marston, Chairman
Public Lands Committee
The Izaak Walton League of America
370 North Ninth Street
Laramie, Wyoming 82070

Mr. Meridan H. Bennett
Wyoming Outdoor Coordinating Council
Box 33
Wilson, Wyoming 83014

Mr. Robert P. Bledsoe, Executive Secretary
Wyoming Wool Growers Association
300 North Center
P.O. Box 115
Casper, Wyoming 82601

Mr. Dean T. Prosser, Jr., Secretary
Wyoming Stock Growers Association
P.O. Box 216
Cheyenne, Wyoming 82001

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80203

January 17, 1973

Mr. Vern Hamre
Regional Forester
Federal Building
324 25th Street
Ogden, Utah 84401

Dear Mr. Hamre:

Our office has reviewed the draft environmental statements concerning herbicide control of sagebrush and wyethia in Utah and Wyoming.

We can foresee no difficulties as long as the conditions which have been established are carried out in actuality and that the areas are managed in such a way as to prevent reoccurrence of the problem.

It is mentioned under J. (11) Planned Measures to Minimize Environmental Impacts, that, when possible, timing of application is done when target species are still susceptible and non-target species are least susceptible to 2,4-D. The timing should be emphasized and made a more stringent requirement. Spraying at other times would just add a burden of 2,4-D on the environment without accomplishing the objective and may possibly defeat many of the planned measures to minimize the environmental impact.

According to the new EPA system of rating impact statements, we have rated this statement LO-1. A copy of explanation of the rating system is attached for your use.

We appreciate the opportunity of reviewing this draft impact statement. Please send us a copy of the final statement when completed.

Sincerely yours,

John L Buchanan

for John A. Green
Regional Administrator

Enclosure

WYOMING GAME AND FISH DEPARTMENT COMMENTS ON REVIEW OF U.S.F.S R4 USDA DRAFT ENVIRONMENTAL STATEMENT "HERBICIDE CONTROL OF SAGEBRUSH AND WYETHIA IN WYOMING" AS FORWARDED TO THE HONORABLE RUSSELL E. TRAIN, CHAIRMAN COUNCIL ON ENVIRONMENTAL QUALITY, December 1, 1972.

The subject statement has been reviewed by personnel of this department and is believed to be lacking in the following areas of consideration as indicated.

1. The accuracy and factuality of some information presented.
2. The inclusiveness of available information.
3. The accuracy of analysis of information presented and available.
4. The accuracy of problem and policy issue identification.
5. The adequacy and thoroughness of discussion of alternatives to the proposed action.

1. Erroneous data and factual information presented includes:

The discussion on mule deer which is generally good, however, p. 11 par. #3 includes data suggesting deer cannot utilize sagebrush without other forage species. A thorough analysis of the methods used by the authors referred to will show that this was not substantiated on free-ranging deer. Also, the reported effects of essential oils of sagebrush detrimentally affecting digestion of this species in free-ranging deer is highly questionable, and this was even admitted by the authors of reference 24 since their tests were only in test tubes and in a fistulated "domestic" steer.

p. 31, Item 4 - There is absolutely no statement made in either reference 14 or 24 that gives a limit of 45 percent sagebrush as desirable in the diet of deer.

p. 24, Item 4 - One of the main justifications for deer and antelope forage enhancement by sagebrush eradication is that other desirable "browse" species will develop to replace the sagebrush. In theory this sounds great, however, on much of the sagebrush range no other browse species may exist. The reason being that they are not adapted to the specific soil type or site.

The section on elk (item 3 p. 12) is generally true, yet the authors are apparently unaware that Ward (U.S.D.A.F.S. Rocky Mountain Forest and Range Experiment Station-Laramie) has found that elk in the Snowy Range select sagebrush in the winter diet out of proportion to its presence in the plant community. It is interesting that apparently none of their research personnel making game food habit studies in Wyoming are on the reviewers' list.

In sagebrush areas adjacent to and including some lands in the forest that are known calving areas treatment to eliminate sagebrush, may adversely affect natural reproduction of elk.

p. 25-26, Item H - There is a general admission that sagebrush control may not be beneficial to deer, antelope and sagegrouse. Although there is an attempt to qualify this, the fact remains this practice can only benefit grazing species such as cattle, horses, sheep (in summer) elk and bighorns and perhaps deer if other desirable species might replace the sagebrush.

p. 31, Item 5 - Adverse effects on rodents are reported. We submit that rodent reductions would certainly adversely affect predatory birds and mammals.

2. In order that the statement can be more inclusive, the following list of some of the more common species of birds and mammals that should be accounted for under the section beginning on page 8, of the draft report.

"AFFECTED BIRDS AND MAMMALS"

| Birds | Mammals |
|---|---|
| Ferruginous Hawk | Merriam Shrew |
| Golden Eagle | Black-Footed Ferret |
| Prairie Falcon | Badger |
| Mountain Plover | Kit Fox |
| Burrowing Owl | Coyote |
| Sage Sparrow | Uinta Ground Squirrel |
| McCown's Longspur | Least Chipmunk |
| | Whitetail Prairie Dog |
| | Northern Pocket Gopher |
| | Silky Pocket Mouse |
| | Ord Kangaroo Rat |
| | Great Basin Kangaroo Rat |
| | Wood Rat |
| | Longtail Vole |
| | Bobcat |
| | Sagebrush Vole |
| | Whitetail Jackrabbit |
| | Desert Cottontail |
| | Mountain Cottontail |

The references listed 9, 33 do not cover areas of sagebrush in association with forest fringe or forest interior openings. More complete accounting for the impact of sagebrush removal on small non-game birds and mammals of prey species may well invalidate the observation on page 10:

(4) Predatory Birds - "Spraying sagebrush does not appear to have any significant effect on predatory birds".

If prey species are reducted and removed, predators will either have to leave the area of prev on other available species i.e., domestic sheep and game species. There is literature on the omitted species.

(1) Sage grouse. (b) Spring and Summer. Page 9, paragraph 5. Strip spraying will be avoided, irregular patterns or contour patterns are much better, with leave area for travel ways and habitat requirements maintained.

There has been no mention of or indication of consideration of the Western States Sage grouse Committee's Guidelines for Habitat Modification of Sage grouse Range or Habitat, except for provision for 100 foot leave strips along water ways. Where any control by herbicide is done, or any modification of the habitat is made these guidelines should be followed as close as possible, until better data is available.

Number (5) should be added under this section to account for Blue and Ruffed Grouse. Page 10, the sagebrush-grassland type relationship exists again with the grouse species. The various species of sagebrush and their associated species of grasses and forbs make up an important food and cover system of the forest grouse habitat.

When the blue and ruffed grouse chicks hatch, like the sage grouse, they are also highly dependant upon insects for food. Since the insects are more readily available in the sagebrush-grass-forb community and the sagebrush furnishes optimum protective cover, the sagebrush areas are utilized and are an essential part of the blue and ruffed grouse brood habitat.

On page 10, the section of antelope is both inadequate and erroneous. Interestingly enough, it completely ignored the report done by Charles Sundstrom (USFS Adm. Rept. 2620). This work on the food habits of antelope in the Mosquito Lake sprayed area of the Bridger National Forest substantiates that these animals selected a high percentage of sagebrush. Where 85 percent of the sagebrush was killed, antelope rumens contained 52 percent browse of which 46 percent was sagebrush. An appendix table from our soon-to-be available publication on antelope food habits is also enclosed to further substantiate the preference and dependence pronghorn have for the woody sagebrush species.

Page 14, add (g) in tabulation showing cost for loss of forage for wildlife. (G) In explanation unlike the situation existing whereby domestic livestock grazing is deferred in management plan, which is accounted for in "an adjustment in usable forage is made to account for the rest period." There is no indication of the need for adjustment in usable forage determinations made for wildlife.

The importance of this need is indicated on page 15, under 4. Other Benefits Not Calculated. "In reality, a forage allowance is made for use by wildlife to the extent that they maybe able to take advantage of additional forage production." The example of a limiting factor,

such as a shortage of winter range is well taken, however, there should be direct reference to the potential conflict of the prime objective of the proposed action and the maintenance of winter range for wildlife. See table #7, page 21, "Food Preferences, carrying capacities and forage competition between antelope and domestic sheep in Wyoming's Red Desert," by Keith Severson, Morton May, William Hepworth-Science Monograph 10-1968 Agricultural Experiment Station, University of Wyoming. This analysis of antelope to average 54.7% in summer, 57.9% in fall and 90.4% in winter of 1964. Other information in the above report indicates, that the snow conditions during the winter were more severe than normal. Supporting narrated conclusions indicate that sagebrush species are important for survival of antelope in winter ranges.

Animals, birds and insects - page 26, paragraph 2. No consideration has been made of the physiological changes of the habitat from herbicide treatment of the area upon the micro organisms and insects and the food chain of all animals involved within the area.

The impact on fisheries is avoided in this statement. In that the proposal is of a broad general nature, it must be assumed that areas of importance to fisheries will be considered in specific proposals additional impact consideration should be given to this resource.

> Mule Deer. last paragraph, page 11. Animals consuming a high percentage of sagebrush could suffer from malnutrition. "Replacing sagebrush thru chemical treatment with other suitable plant," is suggested as a benefit to wildlife. What type of plants or species of plants would replace the sagebrush? And how much time would it require to have available other species of plants that would be beneficial to wildlife? In critical wintering areas where sagebrush is the only plant available because of heavy snows, eradication of the sagebrush would also eliminate the deer.

Areas lying in or near prime moose habitat, particularly winter range, should not be treated if it would be detrimental to other needed species of plants.

Emphasis should be added to the impact statement to specify that each individual sagebrush control project proposal should be separately considered, and that an important consideration to antelope populations as well as to other wildlife is maintenance of sufficient winter forage including sagebrush species.

Another omission noted is that not one university specialist in the field of wildlife conservation, animal or plant ecology is represented in the distribution list. (Item 4, page 51)

3. A number of instances appear in this draft indicating erroneous analysis of data and factual information are combined with insufficient information to arrive at an invalid conclusion. Some examples are listed below:

   Grazing of antelope within the forest areas for the most part is not

importance as very little grazing is realized as the result of antelope on forest lands, winter or summer, but in cases where there could be grazing of antelope on forest lands, there is no emphasis on the importance on page 10, paragraph b. mammals.

p. 12, (4) Bighorn Sheep - Winter food habit studies of Rocky Mountain Bighorn Sheep J. W. Todd, Colorado Coop. WL. Res, Unit. Graduate report January - March 1972, Volume 25, Number #2, conducted in Colorado have shown that on some instances as much as 47% of their winter diet was comprised of browse species. The same study indicated A. firgiola was not only a preferred species, but also a prime constituent of the winter diet and accounted for 94% of the ingested shrubs. Observations on the Whiskey Basin Bighorn Sheep winter range by Wyoming Game and Fish Personnel support the findings of the Colorado study.

p. 13, Item F - Increase forage is the goal and since livestock forage is receiving emphasis, browse production for game is not a major consideration. On page 4, under (b) Purpose. It is stated that the reason for existing conditions i.e., areas dominated by sagebrush and wyethia, which are proposed for treatment are due to improper grazing practices coupled with drought periods.

On page 15, under (2) Project Economic Returns. It is stated that the benefits of the project "production may top off, as a balance between target species and other perennial vegetation is reached." Using twenty (20) years as a minimum average duration of effectiveness of treatment, implies that either a climax condition will not or cannot be reestablished under anticipated management practices, or that a climax condition is not desired or judged to be the most productive. These implications do not in themselves justify the treatment of the supposed offered alternative. (G) Intensive Range Management without Sagebrush Treatment.

As offered and accounted for, this is not offered as an alternative to Herbicide Treatment.

This alternative should be fully explored and accounted for, prior to any selection of alternatives or decision making on the proposed project.

p. 15, Item 4 - It is suggested here that sagebrush spraying since 1965 has been beneficial to sage grouce. This conclusion is based on a reference study done in Nevada, which we feel is not relevant to the situation in Wyoming.

The weight of the proposal is towards increasing grass production and slowing erosion. This is primarily aimed at aiding the livestock industry and downstream water users. Where only elk and bighorn sheep are present, increased grass production might be desirable. However, where a fencing and rest rotation grazing management program is also instituted (and this must be done according to some management philosophy criteria)(page 19, par, K) spraying quite likely will not be beneficial to these wildlife species in many instances.

p. 19, Item K - The term "intensive management" should be defined. It is implied that since permittees are not required to reduce stocking on their allotment, that excessive use could result on areas adjacent to the spray. Also, the statement implies that additional stocking might result. What would the benefits be then to elk, deer, antelope and bighorns? A game manager can only hope that the species he manages can find the winter pasture that was not heavily grazed the previous year.

p. 22-23, Item 3 - Since both deer and antelope prefer forbs over grass, reduction in forbs is not beneficial to these species.

p. 24 6, Aquatic Veg. - We do not feel 100 ft. buffer strip to be sufficient. Unanticipated winds, flagging or marking errors, or pilot error could easily violate a buffer zone this small. Riparian vegetation such as Salix in Wyoming are many times habitat areas for wildlife species, such as, moose and beaver.

III FAVORABLE ENVIRONMENTAL EFFECT, page 28.

G. Animals

6. Sage grouse, page 31.

This is not applicable to sage grouse winter range in heavy snow cover areas, even though it involves sage grouse brood areas, in this case the winter habitat requirements should be maintained.

IV ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED, page 32.

F. Animals and birds, page 34.

Herbicide control should not be made on brood areas of sage, blue and ruffed grouse during the brooding period. Also no control should be made on known nesting areas of birds during the nesting period. Since the size of territories varies with the species, but is usually very restricted and small. Controls during these periods could adversely affect the populations within these areas.

4. The accuracy of problem and policy issue identification is questioned in as much as the statement does a worthy job of outlining the livestock grazing and watershed benefits to be derived from vegetative control. It does not, however, evaluate the need to do this control work. Seemingly, all are agreed that control is necessary. Perhaps we should be furnished with data to justify that no control is not a valid alternative (page 42, par. H) There is strong evidence to suggest that some more desirable wildlife species such as deer, antelope and sage grouse will not be benefited in many cases. This is particularly true when the second step in a control program is allotment fencing and rest rotation grazing management. The report does injustice to negative implications and harmful effects on most species; more notable those not classed as game species.

p. 17, Item H - One could argue that, since 2,000 acres of sagebrush

control per year have little effect on forage for wildlife, the value of this program for livestock grazing should make little difference also. In other words, why spray sagebrush and wyethia?

It appears to this reviewer, that the problem of main concern throughout the statement is how to justify Herbicide Control of sagebrush and wyethia. This is not in accordance with the purpose and intent of the N.E.P.A. and E.P.A.

5. In order that alternatives can be equally considered in the decision making process, the primary proposal "Herbicide Control of Sagebrush and Wyethia" should be discussed and evaluated in the same light and to the same degree as the other alternative offered. In this light, and since the authors recognize that over grazing by livestock was the probable cause for range deterioration, they should also recognize that rehabilitation might also be accomplished without plant species eradication and without a fenced rest rotation grazing program.

Range Management without Sagebrush Treatment.

As offered and accounted for, this is not offered as an alternative to Herbicide Treatment.

This alternative should be fully explored and accounted for, prior to any selection of alternatives or decision making on the proposed project.

The "no action" alternative should be considered in the light of discontinuing the recognized cause of the existing problem.

It is also recognized that after recovery period burned areas compared favorably with another treatment method! Perhaps this alternative should be evaluated in the light of comparing the benefits to the economic costs. It has been previously noted that the economic cost tabulation of the primary proposal has not included the cost to the fish and wildlife resource. This consideration may well have placed the primary proposal in an economically unfeasable category.

Thank you for the opportunity to review and comment on this statement.

James B. White, Commissioner
Wyoming Game and Fish Commission

JBW/HEM/cmc

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 2440, Casper, Wyoming 82601

January 10, 1973

Vern Hamre, Regional Forester
Federal Building
324 25th Street
Ogden, Utah 84401

Dear Sir:

The draft environmental statement regarding herbicide control of sagebrush and wyethia in Wyoming has been reviewed by the staff of the Soil Conservation Service. It appears to be factual and complete.

There is a point on page 24 that could be expanded to make the statement more complete. Refer to section No. 4, line No. 11. We feel that "or livestock" could be added behind "big game."

Some rephrasing of material and reorganization may help to clarify the remainder of the statement, but it appears well prepared.

Thank you for the opportunity to comment.

Blaine O. Halliday
State Conservationist

cc:
K. E. Grant, Administrator, SCS, Washington, D. C.
Dr. T. C. Byerly, Coordinator of Environmental Quality Activities, USDA, Washington, D. C.
K. L Williams, Director, RTSC, Portland, Oregon

THE UNIVERSITY OF WYOMING

P. O. BOX 3354 UNIVERSITY STATION

PLANT SCIENCE DIVISION
COLLEGE OF AGRICULTURE
AND EXPERIMENT STATION

LARAMIE, WYOMING 82070

WEED CONTROL

January 2, 1973

Mr. Vern Hamre
Regional Forester
Federal Bldg.
324 - 25th Street
Ogden, Utah 84401

Dear Mr. Hamre:

I appreciated receiving a copy of the environmental statement describing the proposed practice of herbicide control of sagebrush and wyethia in Wyoming by the Forest Service and having the opportunity to review the manuscript.

The Forest Service is to be commended on preparation of the statement and more important that at least one governmental organization realizes the importance of the sagebrush control program as it applies to range improvement.

I would like to make a few comments concerning the environmental statement which I hope will not be considered as being critical of your preparation.

Since Wyoming has had a rather ambitious program over the past 15 or so years, many ecologists, environmentalists, etc. assume that sagebrush is being eliminated from the ecosystem. I find no where in the manuscript a statement to the effect that less than 6 percent of the adaptable acreage has been controlled and much of the original areas sprayed are ready for a second application.

I wonder what you are referring to when you state different chemicals and formulations, summary sheet on page 22? Other than 2,4-D and 2,4,5-T either as an ester or amine formulation or being applied in oil, water or as an invert I am not aware of other economically feasible treatments. In some instances 2,4-D amine has been utilized in areas where 50 percent or less control is desired.

I am in agreement with the summary of citation number 7, page 11, second paragraph, however, to complete the report I think you should have also stated that Dietz et al. showed that mule deer used during the trials refused to eat big sagebrush when fed alone and lost weight on the alfalfa-sagebrush diet. These statements surely adds to the conclusion that deer cannot survive at length on a sagebrush diet.

Smith, A. D., "Sagebrush as a Winter Feed For Deer", J. of Wildlife Manage., 14(3), 285-289 (1950) reported that "of four doe and two bucks fed a choice of big sagebrush (A. tridentata) and black sagebrush (A. nova), one doe refused to eat, one died, two doe ate so little they were removed from the test, and put on more desirable feed." There are many more reports that could be cited to show that sagebrush is consumed by specific game animals but not in the quantities that some game management people would like the general public to believe.

The fact that Artemisia species are highly nutritious is another factor poorly understood and used by some to help deter a sagebrush control program. They never state that although nutritious it is unpalatable.

I have to be somewhat critical of your costs of chemical control although I realize this is project costs. A private land owner pays in the neighborhood of $3.50 per acre now. A few years ago the costs were as low as $2.35 per acre, and these costs include all flagging and application.

Again I realize that the statement, last paragraph, page 14, is true from your management standpoint. Research by Dixie Smith, former Forest Service employee, and the work at the University of Wyoming showed no advantage to deferring sprayed rangeland past the fall of the year sprayed. The lands controlled by the Forest Service would, in most cases, be in a condition that would not require the deferment.

The amine formulation of 2,4-D (page 41) is not compatable with oil and is therefore not utilized in aerial applications where oil is used as a carrier.

The 2000 acres a year that you are contemplating to spray is such a minute amount that the true value of the program may never be realized.

Again I conpliment you on a fine summary and statement. You may want to obtain a copy of "The Use and Effects of Pesticides for Rangeland Sagebrush Control", which was recently published by the Midwest Research Foundation under a grant from the U. S. Department of Interior and EPA.

Thank you.

Sincerely,

Harold P. Alley
Professor
Weed Science

HPA:lb

cc: Lee Painter

# AGRICULTURAL EXTENSION SERVICE

College of Agriculture, University of Wyoming, and U. S. Department of Agriculture Cooperating

State Offices
Agriculture Building
Box 3354, University Station
Laramie, Wyoming 82071
(307) 766-3258

December 27, 1972

Mr. Vern Hamre, Regional Forester
Federal Building
324 25th Street
Ogden, UT 84401

RE: 1940 (2200)

Dear Mr. Hamre:

I appreciate the opportunity of reviewing the draft environmental statement regarding control of sagebrush and wyethia with herbicides in Wyoming. Your staff has done a most commendable job in preparing the statement, and I have no substantive comments regarding either additions or deletions.

I do have two comments with respect to terminology.

1) The term "control" can have either positive or negative connotations, depending upon the bias or point of view of the reader. I prefer to use terms such as management, manipulation or modification as much as possible. I note that these other terms are used fairly often, yet I believe that the word "control" could be used even less often.

2) The term "density" refers to numbers of plants per unit of area. It is used correctly in most instances although I believe its usage on the last line of page 6 is in error, and the appropriate term there is ". . . canopy cover of approximately 30 percent."

I also feel that the increase which should result from seeding (p. 17) probably would be more than .4 AUM/acre, perhaps closer to .6 AUM, but this is not of any importance regarding the overall statement.

I would hope that the statement can be swiftly adopted in its present form. The continued use of appropriate herbicides in resource management is vitally necessary, more so now than in the past, since much more is known regarding their use to create, restore, or maintain stable rangeland ecosystems.

Sincerely yours,

Thomas E. Bedell
Extension Range Specialist

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TEB:ck

THE UNIVERSITY OF WYOMING

MAILING ADDRESS:
UNIVERSITY STATION
P. O. BOX 3354
LARAMIE, WYOMING 82070

PLANT SCIENCE DIVISION
COLLEGE OF AGRICULTURE
AND EXPERIMENT STATION
AGRICULTURAL BUILDING

RANGE MANAGEMENT
SECTION

LARAMIE, WYOMING 82070

Dec 27, 1972

Dear Vern,

I am leaving with 16 students for Mexico today & will not be back in time for your deadline so secretary or no secretary I am writing you.

Thanks for letting me see the environmental statement on sagebrush and wyethia. I found it to be an up to the minute and sophisticated report. I can find nothing in it to criticize.

My hope now is that an equally detailed and authentic report on the big game situation may some day be forthcoming.

Happy New Year

Alan Beetle
Prof
Range management

Box 33
Wilson, Wyoming 83014

January 8, 1973

Mr. Vern Hamre, Regional Forester
U. S. Forest Service
324 25th Street
Ogden, Utah 84401

Dear Mr. Hamre:

We would like to compliment you on a very thorough and informative draft environmental statement describing proposed applications of 2,4-D for controlling sagebrush and wyethia in Wyoming.

Please consider the following comments in the preparation of the final environmental statement:

1. The draft statement adequately recognized the need for trained personnel to plan and carry out the spraying operations, including flaggers where necessary to assure that spraying does not take place outside the areas designated. However, our main concern (one which has frequently been expressed by Forest Service personnel themselves) is that there may not be the necessary people available, or at least there haven't been on all such operations in the past. With drastic cutbacks in budgets on the National Forests scheduled for the immediate future (see your recent news release re possible consolidation of the Bridger and Teton Forests administrative offices), what assurances are there that close monitoring and control of spraying will actually take place?

2. The data is simply not available to sustain statements purporting to show only slight to negligible secondary effects of 2,4-D, particularly with relation to water quality or to such essential elements of range ecosystems as the legumes. Our best information shows this to be a gap in your data.

3. Adverse effects on animals and birds makes no mention of studies showing possible mutagenicity from 2,4-D. We urge your final statement to take such studies into account.

For reference you might be interested to examine comments submitted for an environmental statement prepared last year on the Beaverhead National Forest's sagebrush control project,

particularly statements by Dr. Meyer Chessin of the University of Montana. Copies may be obtained by writing Regional Forester Steve Yurich, U. S. Forest Service, Missoula, Montana 59801.

In conclusion, I am sure these three specific comments are not new to your office, but we think they should be taken into account in the preparation of the final statement.

Sincerely yours,

Meridan H. Bennett
(For the Wyoming Outdoor
Coordinating Council)

cc: Keith Becker
Wyoming Outdoor Coordinating Council
Box K
Lander, Wyoming 82520

Jake Kittle
VR Ranch
Glenrock, Wyoming

# The Izaak Walton League of America

INCORPORATED

BUILDING A BETTER OUTDOOR AMERICA

370 No. 9th St.,
Laramie, Wyo82&070

Vern Hamre, Regional Forester,
Intermountain Region, U.S.F.S.
324 25th St., Ogden, Utah, 84401

29 Dec. ,1972

Dear Mr. Hamre:

This will acknowledge receipt of your letter of Dec. 6th, calling attention to the accompanying copy of the draft environmental statement concerning proposed herbicide control of sagebrush and wyethia on lands in national forests of the Intermountain Region in Wyoming, which statement, you indicated, has been filed with the Council on Environmental Quality, for its approval and on which your office is inviting statements from interested persons and organizations.

The undersigned has taken time to read most of the lengthy statement and to give it some thought.

May I state, at the outset, that I am much impressed with the scope of the proposal and with the body of information your staff has assembled as a result of your agency's long-time experience in spraying sagebrush with chemicals and with alternate methods of control. I also note the inclusions of statements from independent organizat ions and individuals, from Forest users, other observers and of certain technical information bearing on this subject.

During my nearly life-time residence in Wyoming I have had opportunity to observe some sagebrush control being carried on in different areas of the State. I have seen much good and some poor results in attempts to control, both bythe Forest Service, by BLM, and also by private operators. I have seen some spraying and burning and some chaining on private lands, of not only sagebrush and its associated plant species, but also of other brush (principally willows). Of the latter I definitely disapprove, even recognizing that such control may sometimes save valuable water for irrigation.

Generally, I am much in favor of chemical sprahing, which I believe is the most economical and mosteffective method of control of sagebrush on our Wyoming grazing lands. When used efficiently, as with helicopters, in carefully measured amounts and with well-heeded precautions, I have noticed effective results. It has brought about a noticeable increase in grass and forbes production of from four

to seven times the previous cover. The operation thus makes much more forage available for both livestock and wildlife. In areas which which are not too windswept the elimination of sagebrush also alows more snow to melt and seep into the soil.

I do not think that any high percentage of the sage brush in any one area should be sprayed. Sage brush has some value as forage for sheep and antelope when there is heavy or crusted snow cover in winter. In fact, it sometimes is the only forage available for such forms of wildlife. In areas where sage grouse abound there should be some sage brush left for their cover and feed for the grouse during the off-growing season. Strutting and nesting areas of sage grouse should be fully identified and avoided in sprahing.

In your statement I have noticed that you have taken these and many other factors, both favorable and unfavorable, into consideration, also you have given a logical comparison of the relative costs of the different methods that might be used.

I think that a careful analysis of the various factors involved reveals much in favor of the sprahing program.

I also believe that with the background of experience which the Forest Service has had in this field of range improvement, and with the careful use, precautions, and safety measures you have specified, that the proposed spraying operations with sage brush and certain other undesirable species commonly associated with sagebrush, can be successfully carried on. If this practice is applied on large acreages it can prove to be a very effective tool in improved range forage production and in conservation of moisture and erosion control.

As long as the control is applied only to the specified target species of plants, in open country and with the many precautions you hve indicated will be applied, I can see no justifiable environmental criticism that could be given.

But, if the Forest Servide and other public land agencies involved, treat no more than 2000 acres of such land a year, as you have indicated in this region, many of us will not be around to see any substantial improvement in our lifetime.

You are at liberty to use my comments in any way you feel will be helpful. I hope your proposed program receives the approval you are requesting.

Sincerely yours,

s/ Burton W. Marston

Burton W. Marston, Chairman
Public Lands Committee, IWLA.

Copy to National Office, IWLA

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1306 Kimberly
Rock Springs, Wyoming 82901
January 11, 1973

Mr. Vern Hamre
Regional Forester
U. S. Forest Service
324 25th Street
Ogden, Utah 84401

Dear Mr. Hamre:

I have been asked to comment for the Wyoming Wildlife Federation on the U S D A draft environmental statement on herbicide control of sagebrush and wyethia in Wyoming.

I thought that the statement was very well prepaired. Our first concern is that prior to any spraying of sagebrush or any other practice that could have any affect on the habitate we would request that you contact and work with the local biologist from the Wyoming Game and Fish Department. You indicated that this would be done.

We would also hope that all spray programs attempt to achieve a 70% kill of brush.

You indicate that no brush will be sprayed within 100 feet of any pond, river or streams. Our concern here would be whether or not 100 feet is a sufficient distance to safeguard any bodies of water. We would think that the distance should be much more. We would recommend that any areas considered critical winter wildlife habitate areas not be sprayed.

We would recommend that areas sprayed be irregular in shape and that large blocks should not be sprayed but instead spraying would be confined to strips.

We are in complete agreement with Sect. J, 1 thru 11, "Plan of Measures to Minimize Environmental Impacts."

We would hope that the sagebrush control program be held to no more than 2000 acres each year. This would allow everyone concerned a chance to keep a close check on any effects that might occur.

We would recommend that no aerial spraying be allowed with a fixed wing aircraft.

In behalf of the Wyoming Wildlife Federation I extend our thanks for allowing us an opportunity to review and comment on this program.

Sincerely,

John C. Borzea, Director
Wyoming Wildlife Federation

cc: Jim Ashmore
James T. Noble